Test report

390909-TRFWL

Date of issue: January 25, 2019

Applicant:

J Plus, Inc.

Product:

CBDS Cat-A Indoor CBDS

Model:

JLT – 622P (CBRS)

FCC ID:

2AVGPJLT622P

Specifications:

- FCC 47 CFR Part 96

  Citizens Broadband Radio Service

Lab and test locations

Company name	Nemko USA Inc.
Address	2210 Faraday Ave, Suite 150
City	Carlsbad
State	California
Postal code	92008
Country	USA
Telephone	+1 760 444 3500
Website	www.nemko.com
FCC Site Number	Test Firm Registration Number: 392943 Designation Number: US5058
ISED Test Site	2040B-3

Tested by	Martha Espinoza,Wireless Engineer
Tester signature	
Reviewed by	Chip Fleury, WL & Certification Supervisor
Review date	February 1, 2019
Reviewer signature	

Limits of responsibility

Note that the results contained in this report relate only to the items tested and were obtained in the period between the date of initial receipt of samples and the date of issue of the report.
This test report has been completed in accordance with the requirements of ISO/IEC 17025. All results contain in this report are within Nemko USA's ISO/IEC 17025 accreditation.

Copyright notification

Table of contents

Section 1. Report summary

1.1 Applicant and manufacturer

Company name	J Plus, Inc
Address	14788 NE 95th St
City	Redmond
Province/State	Washington
Postal/Zip code	98052
Country	U.S.A.

1.2 Test specifications

FCC 47 CFR Part 96	Citizens Broadband Radio Service

1.3 Test method

ANSI C63.26-2015	American National Standard for Compliance Testing of Transmitters Used in Licensed Radio Services
KDB 662911	D01 Multiple Transmitter Output V02r01
KDB 662911	D02 MIMO with Cross Polarized Antenna v01
KDB 940660	D01 Part 96 CBRS Eqpt v02

1.4 Statement of compliance

In the configuration tested, the EUT was found compliant.

Testing was completed against all relevant requirements of the test standard. Results obtained indicate that the product under test complies in full with the requirements tested. The test results relate only to the items tested.

See “Summary of test results” for full details.

1.5 Exclusions

This test report covers only general requirements of Part 96. For SAS and functionality please refer to the WINNF test report.

1.6 Test report revision history

Revision #	Details of changes made to test report
390909-TRFWL	Original report issued

Section 2. Summary of test results

2.1 FCC Part 96 test results

Part	Test description	Verdict
§96.41(e)(3)	Emission and occupied bandwidth	Pass
§96.41(b)	Power limits	Pass
§96.41(e)(1)	3.5 GHz Emissions and Interference Limits	Pass
§96.41(e)(2)	Additional protection levels	Pass
§96.41(g)	The peak-to-average power ratio (PAPR)	Pass
§2.1055	Frequency stability	Pass

Notes: None

Section 3. Equipment under test (EUT) details

3.1 Sample information

Receipt date	November 26, 2018
Nemko sample ID number	390909

3.2 EUT information

Product name	CBSD Cat-A Indoor CBSD
Model	JLT-622P (CBRS)
Serial number	Prototype
Revision number	N/A
Software details	EEUT is tested in ETM mode where signal output can go through a specific port and be modulated using a specific modulation scheme. Engineering version

3.3 Technical information

Frequency band	3550–3700 MHz
Frequency Min (MHz)	3555 MHz (10 MHz channel); 3560 MHz (20 MHz channel)
Frequency Max (MHz)	3695 MHz (10 MHz channel); 3690 (20 MHz channel)
RF power Max (W)	0.105 W Conducted; 1.04 W EIRP
Field strength, Units @ distance	46.67, dBuV/M at 17202.40 MHz @ 3 M
Measured BW (kHz) (99 %)	9253 (10 MHz channel); 17973 (20 MHz channel)
Measured BW (kHz) (26 dB)	10426 (10 MHz channel); 19227 (20 MHz channel)
Type of modulation	QPSK, 16QAM, 64QAM
Emission classification (F1D, G1D, D1D)	G7D, W7D
Transmitter spurious, Units @ distance	46.67, dBuV/M at 17202.40 MHz @ 3 M
Power requirements	120V, 60HZ and PoE
Antenna information	The EUT has an antenna array / non-detachable antenna array to the intentional radiator (integrated).

3.4 Product description and theory of operation

The J Plus, Inc. JLT-622P (CBRS) CBSD Cat-A Indoor CBSD has the following key specifications:

10/20 MHz channel bandwidth
Internal antenna gain: 7 dBi (integrated antenna)
Synchrinization: IEEE 1588V2/GPS/Air synchronization with band 48
PoE + Support
Backhaul type: (RJ-45 1000 Base-T)

Environmental charateristics:
Operating temperature: -5°C - +40°C
Operating humidity: 0 % – 80 %
Storage temperature: -40°C – +70°C
Storage humidity: 10% - 95%
Passive cooling (nature convection)

Mechanical characteristics:
Size: 213.36x200.66x50.8 mm (WxDxH) Without bracket.
Weight: < 0.908 Kg. Without bracket.
Material: PC+ABS (IP30)

3.5 EUT exercise details

EUT was controlled via Putty interface from the computer. EUT is tested in ETM mode where signal output can go through a specific port and be modulated using a specific modulation scheme.

3.6 EUT setup diagram

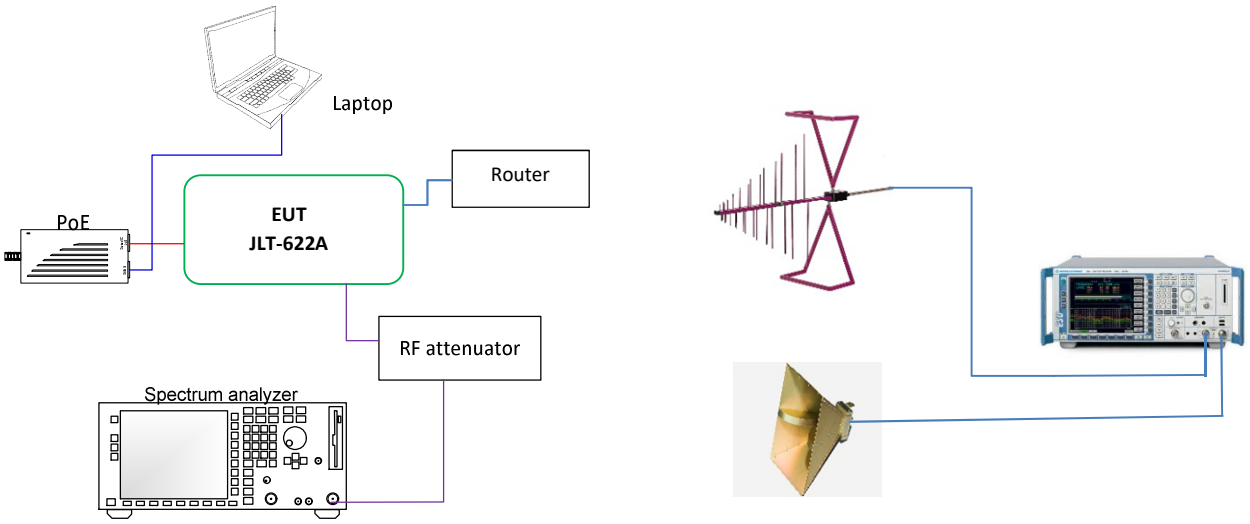


Figure 3.6-1: Setup diagram

3.7 EUT sub assemblies

Table 3.7-1: EUT sub assemblies

Description	Brand name	Model/Part number	Serial number
Power Supply	Liteon	PA-1041-81	C1182001184

Table 3.7-2: EUT interface ports

Description	Qty.
RJ45	3
GPS Antenna	1

Table 3.7-3: Support equipment

Description	Brand name	Model/Part number	Serial number	Rev.
Laptop Computer	DELL	E7470	370006164002	N/A
PoE Injector	Altronix Copr	NetWay1D	N/A	N/A

Table 3.7-4: Inter-connection cables

Cable description	From	To	Length (m)
WAN	EUT	Power supply	<2m
PoE	EUT	PoE Injector	>10m
Management	EUT	Support Laptop	<2m
Bridge	EUT	Router	<2m

Section 4. Engineering considerations

4.1 Modifications incorporated in the EUT

There were no modifications performed to the EUT during this assessment.

4.2 Technical judgment

None

4.3 Deviations from laboratory tests procedures

No deviations were made from laboratory procedures.

Section 5. Test conditions

5.1 Atmospheric conditions

Temperature	15–30 °C
Relative humidity	20–75 %
Air pressure	860–1060 mbar

When it is impracticable to carry out tests under these conditions, a note to this effect stating the ambient temperature and relative humidity during the tests shall be recorded and stated.

5.2 Power supply range

The normal test voltage for equipment to be connected to the mains shall be the nominal mains voltage. For the purpose of the present document, the nominal voltage shall be the declared voltage, or any of the declared voltages ±5 %, for which the equipment was designed.

Section 6. Measurement uncertainty

6.1 Uncertainty of measurement

Nemko USA Inc. has calculated measurement uncertainty and is documented in EMC/MUC/001 “Uncertainty in EMC measurements.” Measurement uncertainty was calculated using the methods described in CISPR 16-4 Specification for radio disturbance and immunity measuring apparatus and methods – Part 4: Uncertainty in EMC measurements; as well as described in UKAS LAB34: The expression of Uncertainty in EMC Testing. Measurement uncertainty calculations assume a coverage factor of K=2 with 95% certainty.Measurement uncertainty budgets for the tests are detailed below. Measurement uncertainty calculations assume a coverage factor of K = 2 with 95% certainty.

Test name	Measurement uncertainty, dB
All antenna port measurements	0.55
Conducted spurious emissions	1.13
Radiated spurious emissions	3.78

Nemko USA Inc. has calculated measurement uncertainty and is documented in EMC/MUC/001 “Uncertainty in EMC measurements.” Measurement uncertainty was calculated using the methods described in CISPR 16-4 Specification for radio disturbance and immunity measuring apparatus and methods – Part 4: Uncertainty in EMC measurements; as well as described in UKAS LAB34: The expression of Uncertainty in EMC Testing. Measurement uncertainty calculations assume a coverage factor of K=2 with 95% certainty.

Section 7. Test equipment

7.1 Test equipment list

Table 7.1-1: Equipment list

Equipment	Manufacturer	Model no.	Asset no.	Cal Date	Next cal.
EMC Test Receiver	Rohde & Schwarz	ESU 40	E1121	05-25-2018	05-25-2020
Antenna, Bilog	Schaffner-Chase	CBL6111C	E1480	12-05-2018	12-05-2019
Antenna, Horn	ETS	3117-PA	E1139	01-26-2018	01-26-2020
Antenna, Horn	Sage Millimeter Inc.	SAR-2309-42-S2	E1143	02-13-2018	02-13-2019
Antenna, Horn	Sage Millimeter Inc.	SAR-2309-28-S2	E1148	02-13-2018	02-13-2019
Power Amplifier	Sage Millimeter Inc.	SBL-1834034030-KFKF	E1174	NCR	NCR
Signal Analyzer	Rohde & Schwarz	FSV40	E1120	08-24-2018	08-24-2019
Chamber Temperature	Associated Environmental Systems	HD-210	S1265	06-18-2018	06-18-2019
Attenuator (20dB)	Centrix RF	C407-20	E1201	NCR	NCR

Note: NCR - no calibration required

Section 8. Testing data

8.1 FCC 96.41(b) Output power and PSD

8.1.1 Definitions and limits

Unless otherwise specified in this section, the maximum effective isotropic radiated power (EIRP) and maximum Power Spectral Density (PSD) of any CBSD and End User Device must comply with the limits shown in the following table:

Table 8.1-1: Output power, EIRP and PSD limits.

Device	Maximum EIRP, dBm/10 MHz	Maximum PSD, dBm/MHz
End User Device	23	N/A
Category A CBSD	30	20
Category B CBSD	47	37

8.1.2 Test summary

Verdict	Pass		
Test date	November 27 and 28, 2018	Temperature	22 and 22 °C
Test engineer	Martha Espinoza, EMC & Wireless Test Engineer	Air pressure	1005 and 1001 mbar
Test location	Wireless Bench	Relative humidity	41 and 47%

(i) Category A CBSDs may be authorized by an approved SAS in geographic areas outside of Exclusion Zones before an ESC is approved.

(ii) (iii) Category B CBSDs may only be authorized consistent with information on the presence of a signal from a federal system provided to the SAS by an approved ESC.

Product category A, CBSD according to definition find it on FCC 96.15 and 96.67

A 10 dB attenuator was used for making all the measurements. The correction factor was applied properly in each case, for compensated the loss caused by the 10 dB attenuator and the cables losses.

Test methodology per ANSI C63.26-2015:

- Output Power – ANSI C63.26-2015 Clause 5.2.4.4.1
- PSD per – ANSI C63.26-2015 Clause 5.2.4.5
- Peak-to-Average Ratio - ANSI C63.26-2015 Clause 5.2.6
- Spurious Radiated power measuremtns – ANSI C63.26-2015 Clause 5.5
- Occupied Bandwith – ANSI C63.26-2015 Clause 5.4.3 (26dB) and Clause 5.4.4 (99%)
- Frequency Stability – ANSI C63.26-2015 Clause 5.6

8.1.3 Observations, settings and special notes

The measurement was taken and the final values were compared with FCC limit. That final value was calculate according to the assumption done by the information provided by client: The array antenna system is considered as an uncorrelated system
Considering the previous information, is necessary to add to output power obtained from each measurement the follow equations:

EIRP Measurement = Output power each port + 10 Log (n) + Antenna Gain
PSD Measurement = Output power each port + 10 Log (n) + Antenna Gain

Where "n" is consider as the number of antennas availale on the complete system. In this case, the number of antennas declared by manufacturer are 2. Then:
n = 2 10 log (2) = 3 antenna gain declared by manufacturer = 7 dBi
The test was performed using RMS detector of the spectrum analyzer with RBW of 1 MHz and VBW of 10 MHz. Total power was integrated over 10 MHz.

8.1.4 Test data

Table 8.1-2: EIRP measurement result for 10 MHz channel

Frequency, MHz	Antenna port	Modulation	Output power, dBm/10 MHz	10*Log (n) n = 2	Antenna Gain (dBi)	EIRP dBm/10 MHz	EIRP Limit, dBm/10 MHz	Margin, dB
3555	0	16QAM	17.11	3	7	27.11	30.00	2.89
3625	0	16QAM	17.19	3	7	27.19	30.00	2.81
3695	0	16QAM	18.04	3	7	28.04	30.00	1.96
3555	0	QPSK	16.09	3	7	26.09	30.00	3.91
3625	0	QPSK	18.24	3	7	28.24	30.00	1.76
3695	0	QPSK	17.06	3	7	27.06	30.00	2.94
3555	0	64QAM	16.09	3	7	26.09	30.00	3.91
3625	0	64QAM	16.21	3	7	26.21	30.00	3.79
3695	0	64QAM	17.03	3	7	27.03	30.00	2.97
3555	1	16QAM	17.18	3	7	27.18	30.00	2.82
3625	1	16QAM	17.36	3	7	27.36	30.00	2.64
3695	1	16QAM	17.36	3	7	27.36	30.00	2.64
3555	1	QPSK	16.19	3	7	26.19	30.00	3.81
3625	1	QPSK	16.26	3	7	26.26	30.00	3.74
3695	1	QPSK	16.37	3	7	26.37	30.00	3.63
3555	1	64QAM	16.16	3	7	26.16	30.00	3.84
3625	1	64QAM	16.25	3	7	26.25	30.00	3.75
3690	1	64QAM	16.41	3	7	26.41	30.00	3.59

Table 8.1-3: EIRP measurement result for 20 MHz channel

Frequency, MHz	Antenna port	Modulation	Output power, dBm/10 MHz	10*Log (n) n = 2	Antenna Gain (dBi)	EIRP dBm/10 MHz	EIRP Limit, dBm/10 MHz	Margin, dB
3560	0	16QAM	16.45	3	7	26.45	30.00	3.55
3625	0	16QAM	17.61	3	7	27.61	30.00	2.39
3690	0	16QAM	17.76	3	7	27.76	30.00	2.24
3560	0	QPSK	16.37	3	7	26.37	30.00	3.63
3625	0	QPSK	16.51	3	7	26.51	30.00	3.49
3690	0	QPSK	16.63	3	7	26.63	30.00	3.37
3560	0	64QAM	16.55	3	7	26.55	30.00	3.45
3625	0	64QAM	16.79	3	7	26.79	30.00	3.21
3690	0	64QAM	16.89	3	7	26.89	30.00	3.11
3560	1	16QAM	17.63	3	7	27.63	30.00	2.37
3625	1	16QAM	17.44	3	7	27.44	30.00	2.56
3690	1	16QAM	18.04	3	7	28.04	30.00	1.96
3560	1	QPSK	16.53	3	7	26.53	30.00	3.47
3625	1	QPSK	16.73	3	7	26.73	30.00	3.27
3690	1	QPSK	16.81	3	7	26.81	30.00	3.19
3560	1	64QAM	16.63	3	7	26.63	30.00	3.37
3625	1	64QAM	16.75	3	7	26.75	30.00	3.25
3690	1	64QAM	16.56	3	7	26.56	30.00	3.44

8.1.4 Test data, continued

Table 8.1-4: PSD measurement result for 10 MHz channel

Frequency, MHz	Antenna port	Modulation	Output power, dBm/1 MHz	10*Log (n) n = 2	Antenna Gain (dBi)	PSD dBm/1 MHz	PSD Limit, dBm/1 MHz	Margin, dB
3555	0	16QAM	8.99	3	7	18.99	20.00	1.01
3625	0	16QAM	9.00	3	7	19.00	20.00	1.00
3695	0	16QAM	9.96	3	7	19.96	20.00	0.04
3555	0	QPSK	7.68	3	7	17.68	20.00	2.32
3625	0	QPSK	9.90	3	7	19.90	20.00	0.10
3695	0	QPSK	8.57	3	7	18.57	20.00	1.43
3555	0	64QAM	7.58	3	7	17.58	20.00	2.42
3625	0	64QAM	7.64	3	7	17.64	20.00	2.36
3695	0	64QAM	8.46	3	7	18.46	20.00	1.54
3555	1	16QAM	9.11	3	7	19.11	20.00	0.89
3625	1	16QAM	9.22	3	7	19.22	20.00	0.78
3695	1	16QAM	9.30	3	7	19.30	20.00	0.70
3555	1	QPSK	7.86	3	7	17.86	20.00	2.14
3625	1	QPSK	7.87	3	7	17.87	20.00	2.13
3695	1	QPSK	8.10	3	7	18.10	20.00	1.90
3555	1	64QAM	7.61	3	7	17.61	20.00	2.39
3625	1	64QAM	7.66	3	7	17.66	20.00	2.34
3695	1	64QAM	7.80	3	7	17.80	20.00	2.20

Table 8.1-5: PSD measurement result for 20 MHz channel

Frequency, MHz	Antenna port	Modulation	Output power, dBm/1 MHz	10*Log (n) n = 2	Antenna Gain (dBi)	PSD dBm/1 MHz	PSD Limit, dBm/1 MHz	Margin, dB
3560	0	16QAM	7.61	3	7	17.61	20.00	2.39
3625	0	16QAM	9.19	3	7	19.19	20.00	0.81
3690	0	16QAM	9.45	3	7	19.45	20.00	0.55
3560	0	QPSK	7.45	3	7	17.45	20.00	2.55
3625	0	QPSK	7.52	3	7	17.52	20.00	2.48
3690	0	QPSK	7.71	3	7	17.71	20.00	2.29
3560	0	64QAM	7.62	3	7	17.62	20.00	2.38
3625	0	64QAM	7.77	3	7	17.77	20.00	2.23
3690	0	64QAM	7.93	3	7	17.93	20.00	2.07
3560	1	16QAM	9.39	3	7	19.39	20.00	0.61
3625	1	16QAM	9.16	3	7	19.16	20.00	0.84
3690	1	16QAM	9.52	3	7	19.52	20.00	0.48
3560	1	QPSK	7.63	3	7	17.63	20.00	2.37
3625	1	QPSK	7.84	3	7	17.84	20.00	2.16
3690	1	QPSK	7.59	3	7	17.59	20.00	2.41
3560	1	64QAM	7.71	3	7	17.71	20.00	2.29
3625	1	64QAM	7.89	3	7	17.89	20.00	2.11
3690	1	64QAM	7.78	3	7	17.78	20.00	2.22

.

8.1.4 Test data, continued

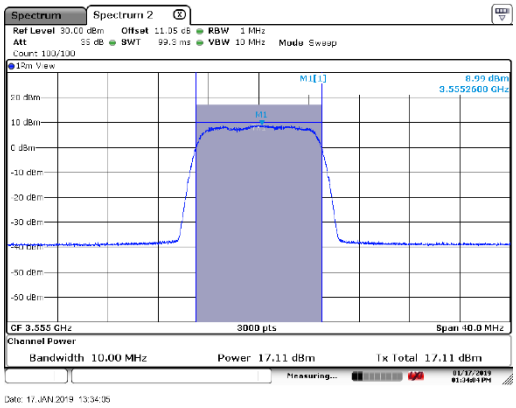


Figure 8.1-1: *Total power and power spectral density sample plot, 10 MHz channel. Port 0, low channel (3555 MHZ), 16QAM.*

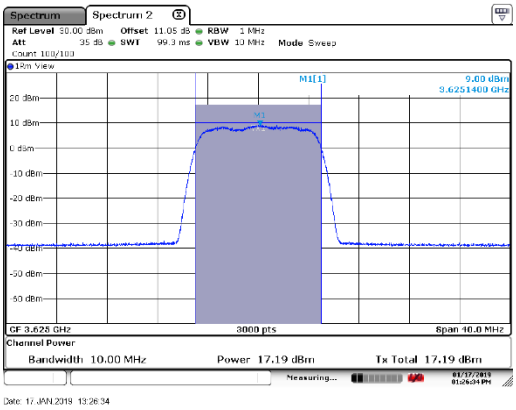


Figure 8.1-2: *Total power and power spectral density sample plot, 10 MHz channel. Port 0, middle channel (3625 MHZ), 16QAM.*

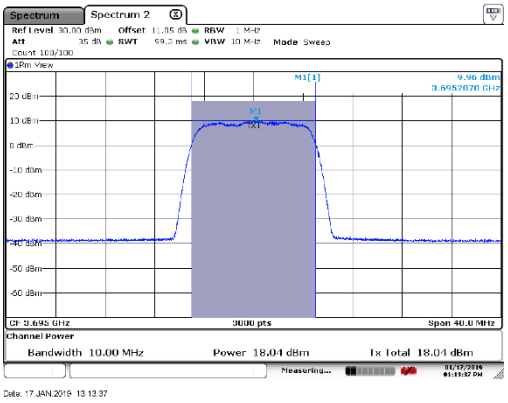


Figure 8.1-3: *Total power and power spectral density sample plot, 10 MHz channel. Port 0, high channel (3695 MHZ), 16QAM.*

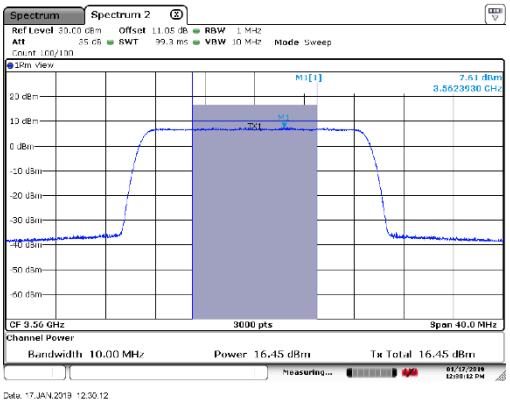


Figure 8.1-4: *Total power and power spectral density sample plot, 20 MHz channel. Port 0, low channel (3560 MHZ), 16QAM.*

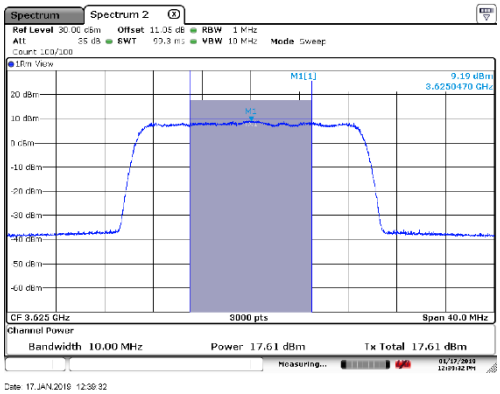


Figure 8.1-5: *Total power and power spectral density sample plot, 20 MHz channel. Port 0, middle channel (3625 MHZ), 16QAM.*

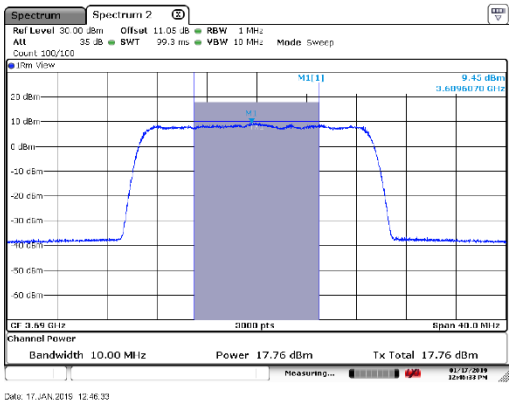


Figure 8.1-6: *Total power and power spectral density sample plot, 20 MHz channel. Port 0, high channel (3690 MHZ), 16QAM.*

Table 8.1-6: Total conducted power output result for 20 MHz channel over 20MHz bandwidth

Frequency, MHz	Antenna port	Modulation	Conducted Output power, dBm/20 MHz	10*Log (n) n = 2	Total dBm/20 MHZ
3560	0	16QAM	19.92	3	22.92
3625	0	16QAM	20.01	3	23.01
3690	**0**	**16QAM**	**20.20**	**3**	**23.20**
3560	0	QPSK	18.93	3	21.93
3625	0	QPSK	19.03	3	22.03
3690	0	QPSK	19.21	3	22.21
3560	0	64QAM	19.06	3	22.06
3625	0	64QAM	19.15	3	22.15
3690	0	64QAM	19.33	3	22.33
3560	1	16QAM	20.08	3	20.08
3625	1	16QAM	20.12	3	23.12
3690	1	16QAM	20.14	3	23.14
3560	1	QPSK	19.15	3	22.15
3625	1	QPSK	19.15	3	22.15
3690	**1**	**QPSK**	**19.28**	**3**	**22.28**
3560	1	64QAM	19.21	3	22.21
3625	1	64QAM	19.32	3	22.32
3690	1	64QAM	19.16	3	22.16

Note: Plots with highest output power displayed below

8.1.4 Test data, continued

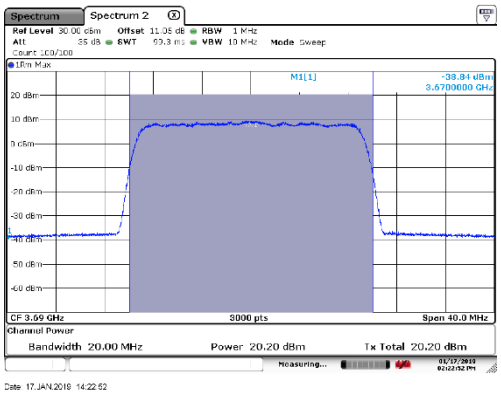


Figure 8.1-7: *Total power and power spectral density sample plot, 20 MHz channel with 20MHz BW. Port 0, High channel (3690 MHZ), 16QAM.*

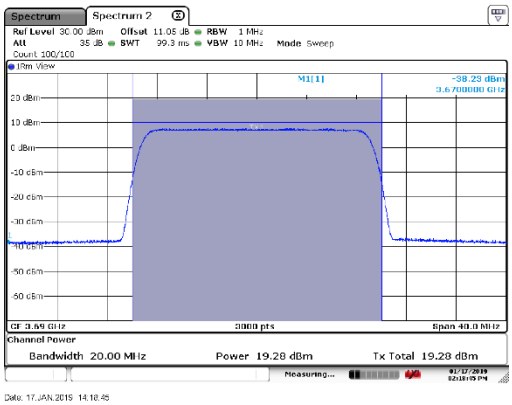


Figure 8.1-8: *Total power and power spectral density sample plot, 20 MHz channel with 20MHz BW. Port 1, high channel (3690 MHZ), QPSK.*

8.2 FCC 96.41(g) The peak-to-average power ratio (PAPR)

8.2.1 Definitions and limits

The peak-to-average power ratio (PAPR) of any CBSD transmitter output power must not exceed 13 dB. PAPR measurements should be made using either an instrument with complementary cumulative distribution function (CCDF) capabilities or another Commission approved procedure. The measurement must be performed using a signal corresponding to the highest PAPR expected during periods of continuous transmission.

8.2.2 Test summary

Verdict	Pass		
Test date	November 28, 2018	Temperature	22 °C
Test engineer	Martha Espinoza, EMC & Wireless Test Engineer	Air pressure	1001 mbar
Test location	Wireless Bench	Relative humidity	47 %

8.2.3 Observations, settings and special notes

The test was performed using spectrum analyzer signal statistics' Complimentary Cumulative Distribution Function

8.2.4 Test data

Table 8.2-1: PAPR measurement results at 10 MHz of bandwith

Channel BW, MHz	Antenna port	Modulation	Frequency, MHz	CCDF at 0.1%, dB	Limit, dB	Result
10	0	16QAM	3555	10.03	13.00	Pass
10	0	16QAM	3625	10.00	13.00	Pass
10	0	16QAM	3695	9.97	13.00	Pass
10	0	QPSK	3555	10.06	13.00	Pass
10	0	QPSK	3625	10.03	13.00	Pass
10	0	QPSK	3695	10.00	13.00	Pass
10	0	64QAM	3555	9.97	13.00	Pass
10	0	64QAM	3625	9.94	13.00	Pass
10	0	64QAM	3695	9.91	13.00	Pass
10	1	16QAM	3555	10.06	13.00	Pass
10	1	16QAM	3625	9.97	13.00	Pass
10	1	16QAM	3695	9.88	13.00	Pass
10	1	QPSK	3555	10.09	13.00	Pass
10	1	QPSK	3625	10.00	13.00	Pass
10	1	QPSK	3695	9.91	13.00	Pass
10	1	64QAM	3555	10.00	13.00	Pass
10	1	64QAM	3625	9.91	13.00	Pass
10	1	64QAM	3695	9.83	13.00	Pass

Table 8.2-2: PAPR measurement results at 20 MHz of bandwith

Channel BW, MHz	Antenna port	Modulation	Frequency, MHz	CCDF at 0.1%, dB	Limit, dB	Result
20	0	16QAM	3560	10.04	13.00	Pass
20	0	16QAM	3625	9.71	13.00	Pass
20	0	16QAM	3690	9.71	13.00	Pass
20	0	QPSK	3560	10.03	13.00	Pass
20	0	QPSK	3625	9.71	13.00	Pass
20	0	QPSK	3690	9.71	13.00	Pass
20	0	64QAM	3560	10.05	13.00	Pass
20	0	64QAM	3625	9.68	13.00	Pass
20	0	64QAM	3690	9.71	13.00	Pass
20	1	16QAM	3560	10.00	13.00	Pass
20	1	16QAM	3625	9.68	13.00	Pass
20	1	16QAM	3690	9.71	13.00	Pass
20	1	QPSK	3560	10.01	13.00	Pass
20	1	QPSK	3625	9.68	13.00	Pass
20	1	QPSK	3690	9.68	13.00	Pass
20	1	64QAM	3560	10.04	13.00	Pass
20	1	64QAM	3625	9.71	13.00	Pass
20	1	64QAM	3690	9.68	13.00	Pass

8.2.4 Example Test data, continued

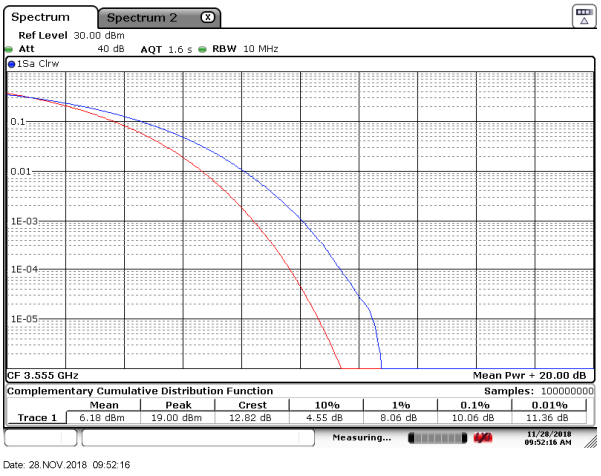


Figure 8.2-1: *CCDF sample plot, 10 MHz channel.Port 1, low channel (3555 MHZ), 16QAM.*

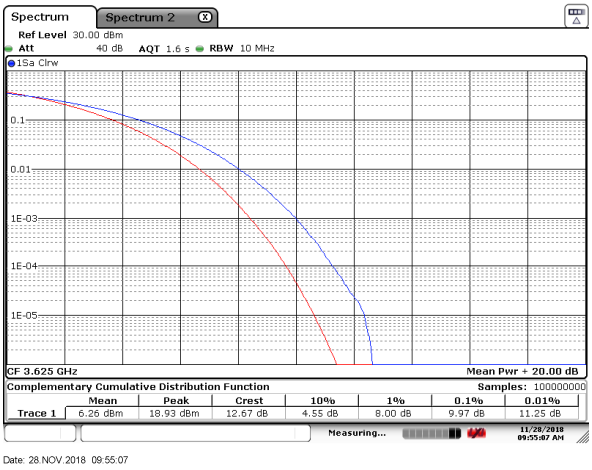


Figure 8.2-2: *CCDF sample plot, 10 MHz channel. Port 1, middle channel (3625 MHZ), 16QAM.*

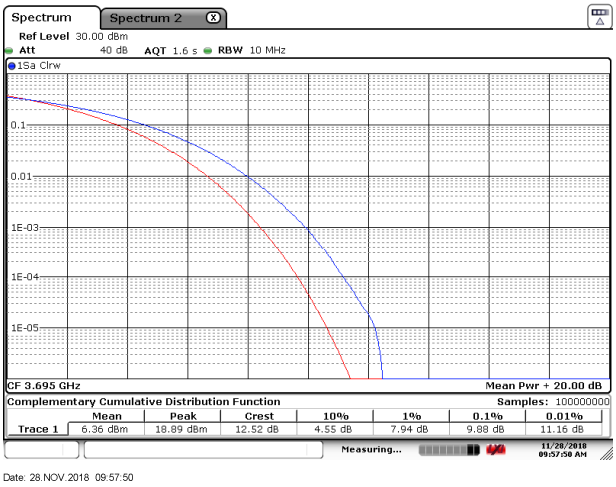


Figure 8.2-3: *CCDF sample plot, 10 MHz channel. Port 1, high channel (3695 MHZ), 16QAM.*

8.3 FCC 96.41(e)(3) Emission bandwidth and occupied bandwidth

8.3.1 Definitions and limits

The emission bandwidth is defined as the width of the signal between two points, one below the carrier center frequency and one above the carrier center frequency, outside of which all emissions are attenuated at least 26 dB below the transmitter power.
FCC 2.1049 The occupied bandwidth, that is the frequency bandwidth such that, below its lower and above its upper frequency limits, the mean powers radiated are each equal to 0.5 percent of the total mean power radiated by a given emission.

8.3.2 Test summary

Verdict	Pass		
Test date	November 28, 2018	Temperature	22 °C
Test engineer	Martha Espinoza, EMC & Wireless Test Engineer	Air pressure	1001 mbar
Test location	Wireless Bench	Relative humidity	47 %

8.3.3 Observations, settings and special notes

Spectrum analyser settings for OBW measurements:

Resolution bandwidth	500 kHz
Video bandwidth	3 MHz
Detector mode	Peak
Trace mode	Max Hold

8.3.4 Test data

Table 8.3-1: Occupied bandwidth measurement results for 10 MHz channel

Frequency, MHz	Antenna port	Modulation	99% OBW, MHz	26 dB BW, MHz
3555	0	16QAM	9.253	10.426
3625	0	16QAM	9.246	10.393
3695	0	16QAM	9.253	10.286
3555	0	QPSK	9.193	10.353
3625	0	QPSK	9.193	10.360
3695	0	QPSK	9.200	10.320
3555	0	64QAM	9.173	10.420
3625	0	64QAM	9.180	10.380
3695	0	64QAM	9.173	10.320

Note: Client declared the port 1 as a symmetrical to port 0.

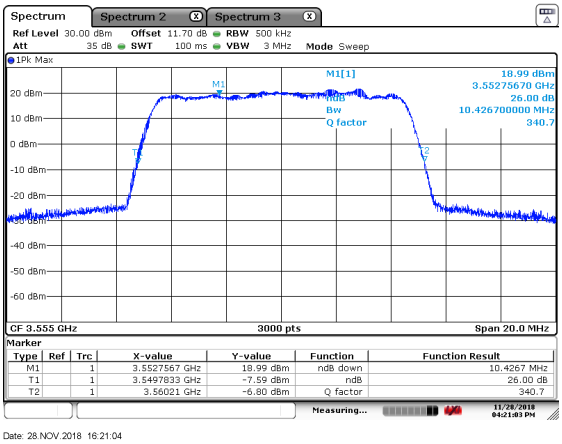


Figure 8.3-1: Occupied bandwidth sample plot for 10 MHz channel (26 dB), port 0, low channel (3555 MHz), 16QAM

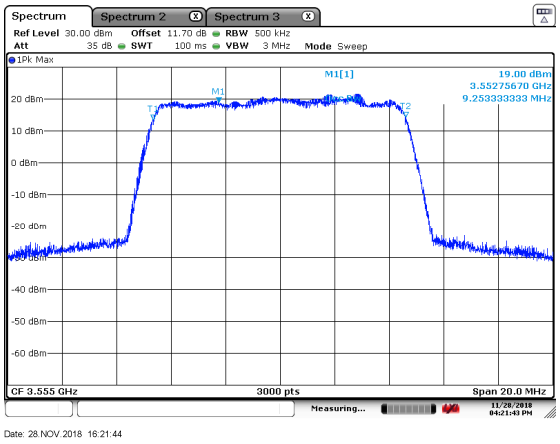


Figure 8.3-2: Occupied bandwidth sample plot for 10 MHz channel (99%), port 0, low channel (3555 MHz), 16QAM

Table 8.3-2: Occupied bandwidth measurement results for 20 MHz channel

Frequency, MHz	Antenna port	Modulation	99% OBW, MHz	26 dB BW, MHz
3560	0	16QAM	17.946	19.160
3625	0	16QAM	17.960	19.200
3690	0	16QAM	17.973	19.187
3560	0	QPSK	17.906	19.213
3625	0	QPSK	17.933	19.227
3690	0	QPSK	17.920	19.213
3560	0	64QAM	17.933	19.227
3625	0	64QAM	17.933	19.200
3690	0	64QAM	17.933	19.213

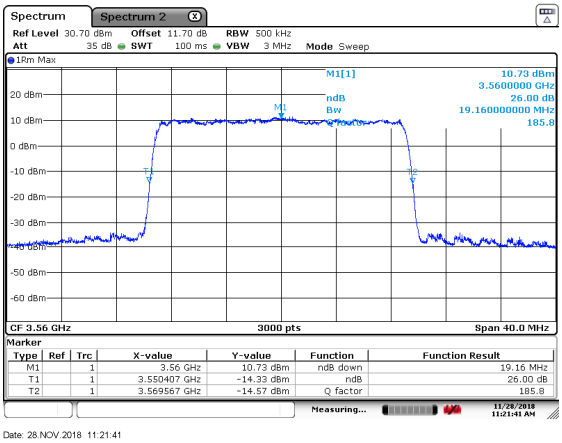


Figure 8.3-3: Occupied bandwidth sample plot for 10 MHz channel (26 dB), port 0, low channel (3560 MHz), 16QAM

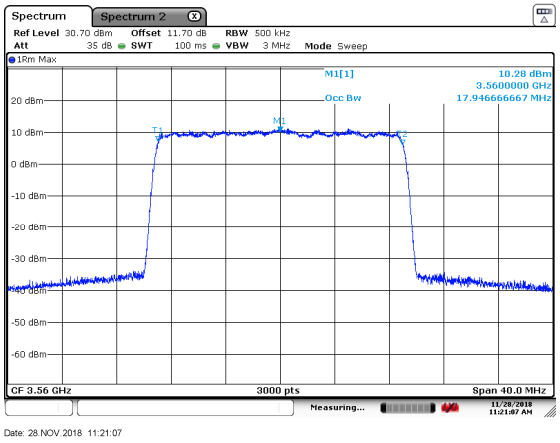


Figure 8.3-4: Occupied bandwidth sample plot for 10 MHz channel (99%), port 0, low channel (3560 MHz), 16QAM

8.4 FCC 96.41(e)(1) 3.5 GHz emissions and interference limits

8.4.1 Definitions and limits

General protection levels. Except as otherwise specified in paragraph (e)(2) of this section, for channel and frequency assignments made by the SAS to CBSDs, the conducted power of any emission outside the fundamental emission (whether in or outside of the authorized band) shall not exceed −13 dBm/MHz within 0–10 MHz above the upper SAS-assigned channel edge and within 0–10 MHz below the lower SAS-assigned channel edge. At all frequencies greater than 10 MHz above the upper SAS assigned channel edge and less than 10 MHz below the lower SAS assigned channel edge, the conducted power of any emission shall not exceed −25 dBm/MHz. The upper and lower SAS assigned channel edges are the upper and lower limits of any channel assigned to a CBSD by an SAS, or in the case of multiple contiguous channels, the upper and lower limits of the combined contiguous channels.

(3) Measurement procedure. (i) Compliance with this provision is based on the use of measurement instrumentation employing a resolution bandwidth of 1 MHz or greater. However, in the 1 MHz bands immediately outside and adjacent to the licensee's authorized frequency channel, a resolution bandwidth of no less than one percent of the fundamental emission bandwidth may be employed. A narrower resolution bandwidth is permitted in all cases to improve measurement accuracy provided the measured power is integrated over the full reference bandwidth (i.e., 1 MHz or 1 percent of emission bandwidth, as specified). The emission bandwidth is defined as the width of the signal between two points, one below the carrier center frequency and one above the carrier center frequency, outside of which all emissions are attenuated at least 26 dB below the transmitter power.

8.4.2 Test summary

Verdict	Pass * see test summary note		
Test date	November 29, 2018	Temperature	20 °C
Test engineer	Martha Espinoza, EMC & Wireless Test Engineer	Air pressure	1001 mbar
Test location	Wireless Bench	Relative humidity	65 %

Test summary Note:
For 10MHz Emissions mask – the closest emission to the limit is -9.87dB from Mid Channel 16QAM plot below. Therefore since this is a conducted limit and the emissions at the antenna port would be from Ports 0 and 1 an additional worst case 3dB has to be added to the result. Therefore the EUT emissions mask worst case emission is 6.87dB under the limit.

For 20MHz Emissions mask – the closest emission to the limit is -11.70dB from Low Channel 64QAM plot below. Therefore since this is a conducted limit and the emissions at the antenna port would be from Ports 0 and 1 an additional worst case 3dB has to be added to the result. Therefore the EUT emissions mask worst case emission is 8.70dB under the limit.

8.4.3 Observations, settings and special notes

Spectrum analyser settings for measurements within 1 MHz from the SAS assigned channel edges:

Resolution bandwidth	100 kHz
Video bandwidth	300 kHz
Detector mode	RMS
Trace mode	Power averaging
Power integration	Over 100 kHz for 10 MHz channel; Over 200 kHz for 20 MHz channel

Spectrum analyser settings for measurements outside 1 MHz from the SAS assigned channel edges:

Resolution bandwidth	1 MHz
Video bandwidth	3 MHz
Detector mode	RMS
Trace mode	Power averaging

A 10 dB attenuator was used for making all the measurements. The correction factor was applied properly in each case, for compensated the loss caused by the 10 dB attenuator and the cables losses.

8.4.4 Test data

Figures: Emission mask measurements for 10 MHz channel.

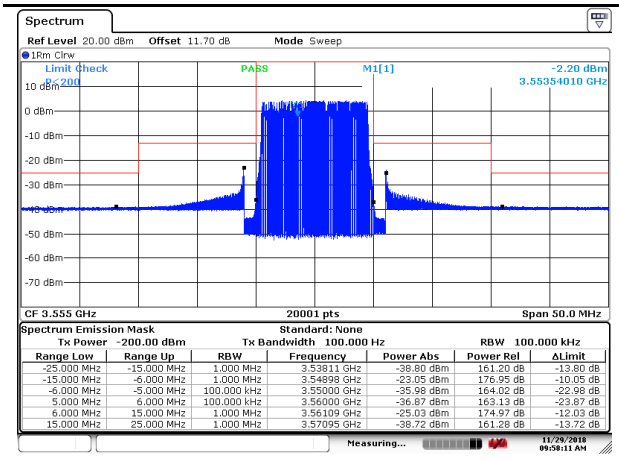


Figure 8.4-1: Emission mask measurements plot port 0, Low channel (3555 MHz), 16QAM

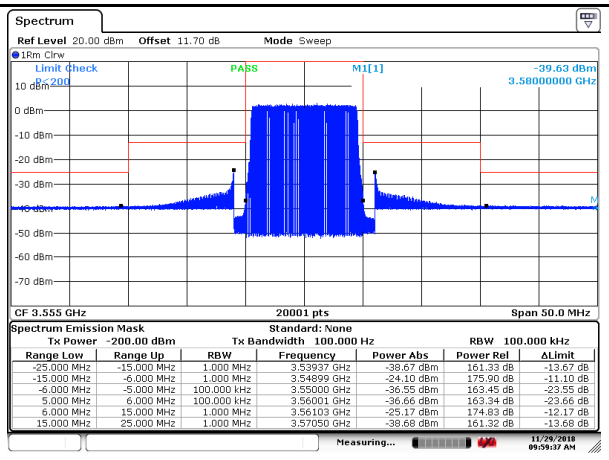


Figure 8.4-2: Emission mask measurements plot port 0, Low channel (3555 MHz), 64QAM

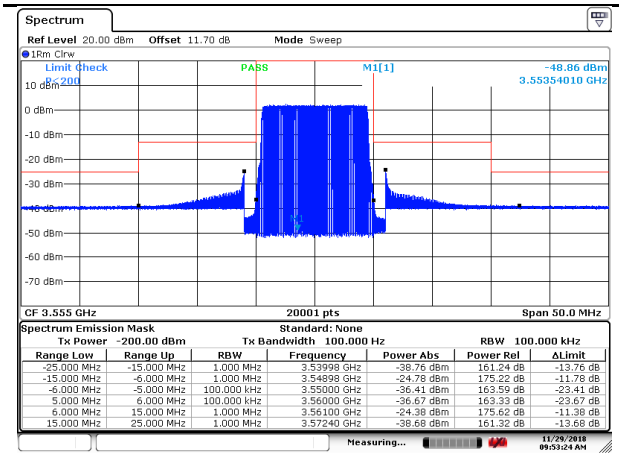


Figure 8.4-3: Emission mask measurements plot port 0, Low channel (3555 Hz), QPSK

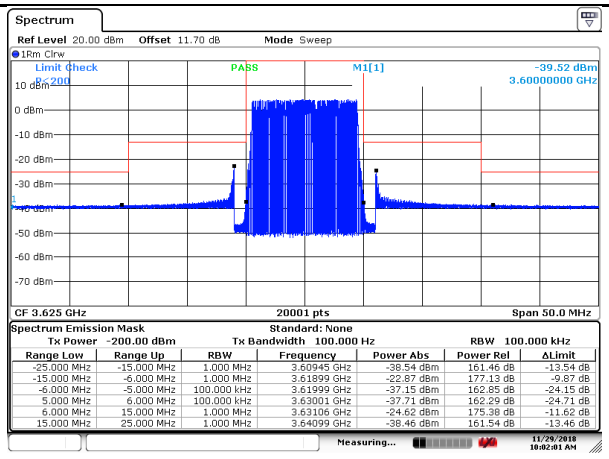


Figure 8.4-4: Emission mask measurements plot port 0, Mid channel (3625 MHz), 16QAM

8.4.4 Test data

Figures: Emission mask measurements for 10 MHz channel Port 0, Low, Mid and High Channel

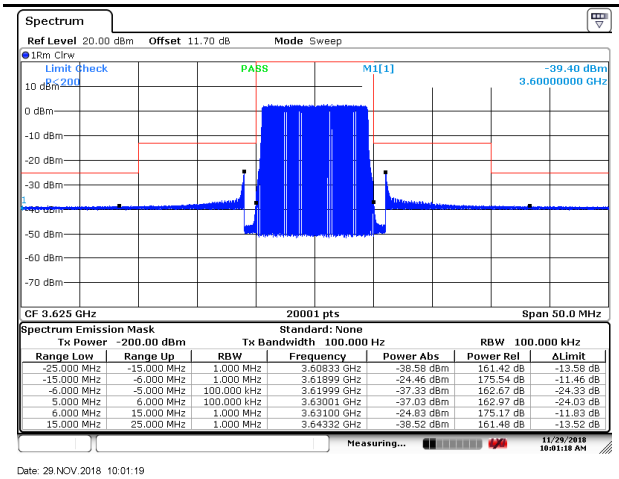


Figure 8.4-5: Emission mask measurements plot port 0, Mid channel (3625 MHz), 64QAM

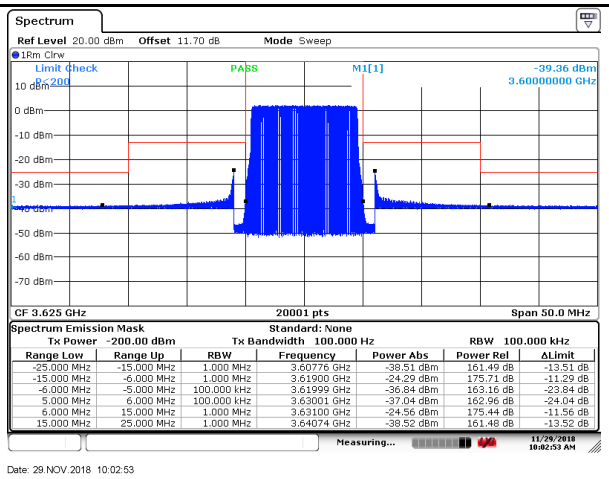


Figure 8.4-6: Emission mask measurements plot port 0, Mid channel (3555 MHz), QPSK

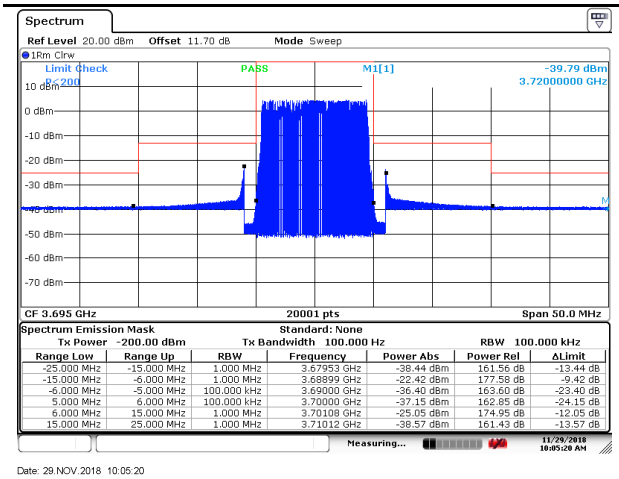


Figure 8.4-7: Emission mask measurements plot port 0, High channel (3695 MHz), 16QAM

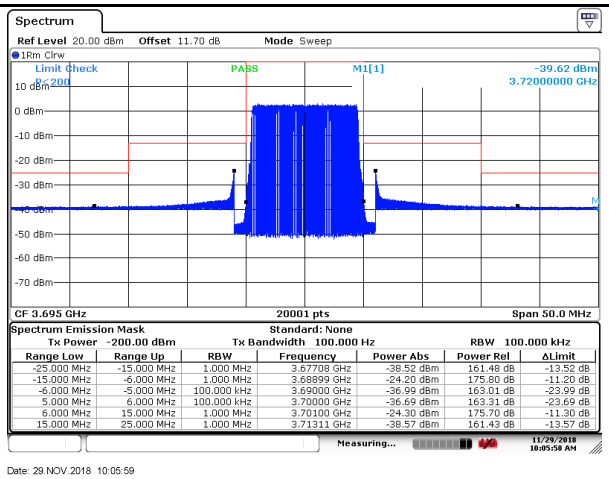


Figure 8.4-8: Emission mask measurements plot port 0, High channel (3695 MHz), 64QAM

8.4.1 Test data

Figures: Emission mask measurements for 10 MHz channel Port 0, Low, Mid and High Channel

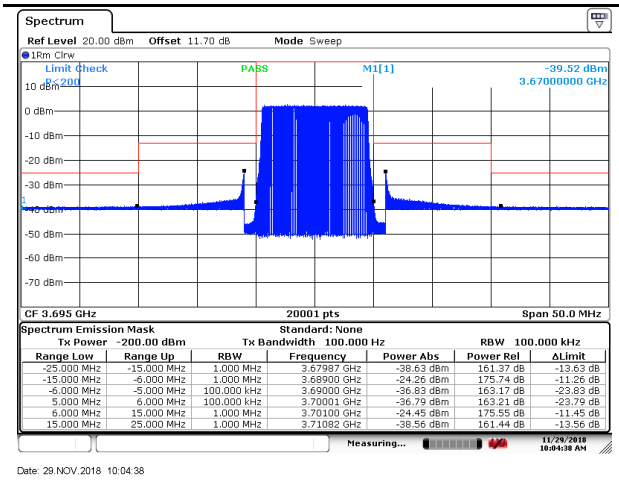


Figure 8.4-9: Emission mask measurements plot port 0, High channel (3695 MHz), QPSK

8.4.4 Test data, continnued

Figures: Emission mask measurements for 20 MHz channel.

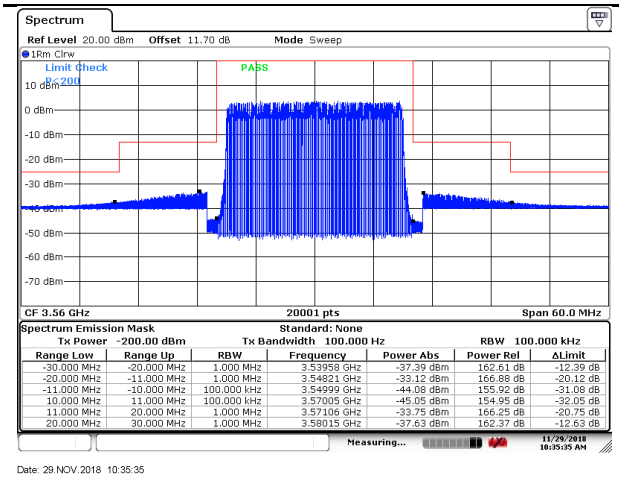


Figure 8.4-10: Emission mask measurements plot port 0, Low channel (3560 MHz), 16QAM

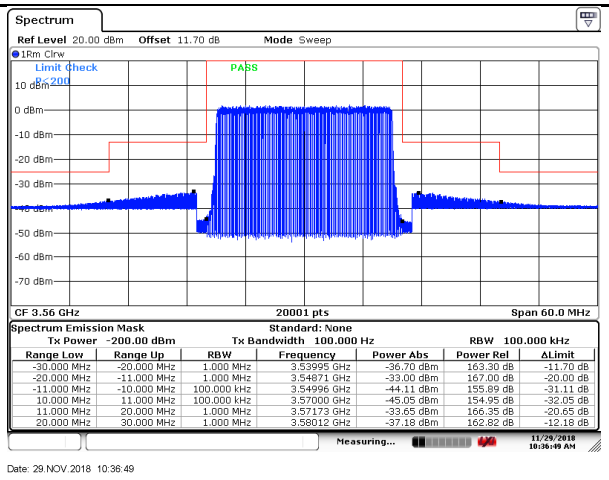


Figure 8.4-11: Emission mask measurements plot port 0, Low channel (3560 MHz), 64QAM

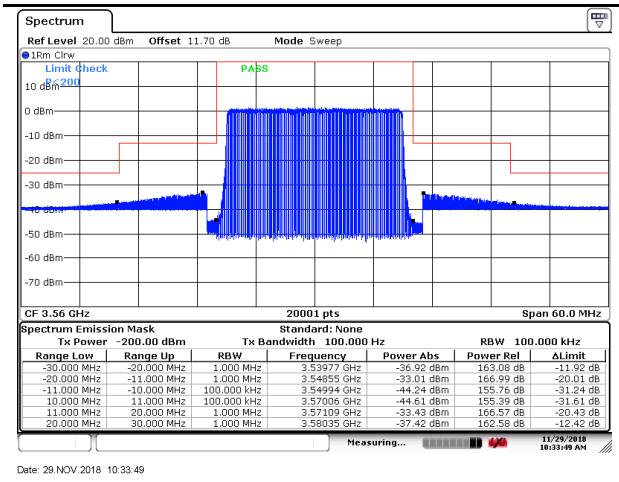


Figure 8.4-12: Emission mask measurements plot port 0, Low channel (3560 Hz), QPSK

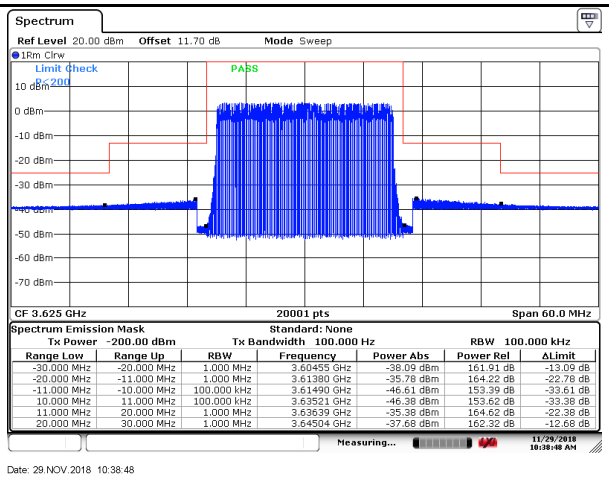


Figure 8.4-13: Emission mask measurements plot port 0, Mid channel (3625 MHz), 16QAM

8.4.5 Test data

Figures: Emission mask measurements for 20 MHz channel Port 0, Low, Mid and High Channel

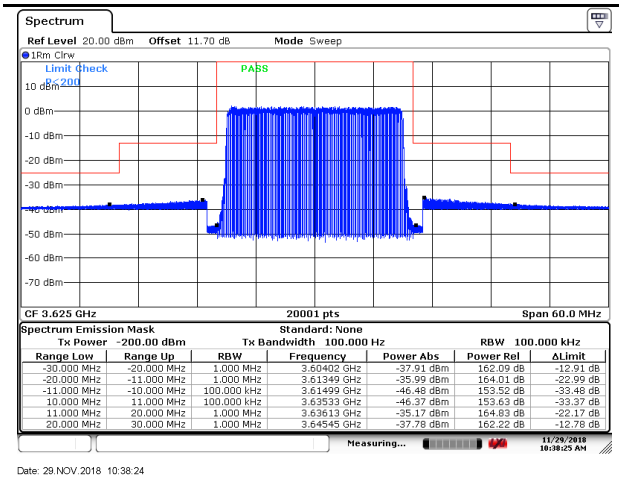


Figure 8.4-14: Emission mask measurements plot port 0, Mid channel (3625 MHz), 64QAM

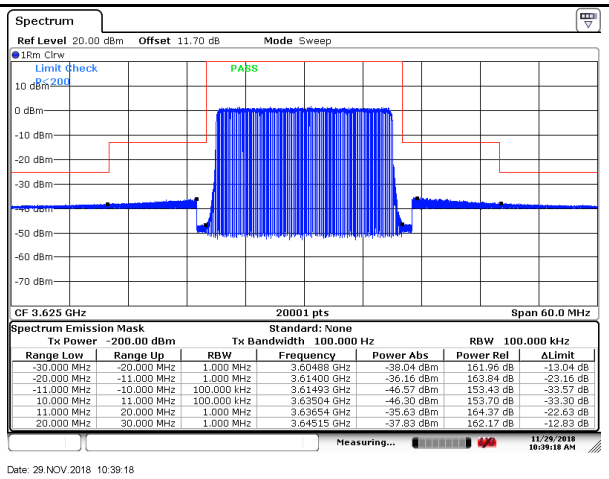


Figure 8.4-15: Emission mask measurements plot port 0, Mid channel (3555 MHz), QPSK

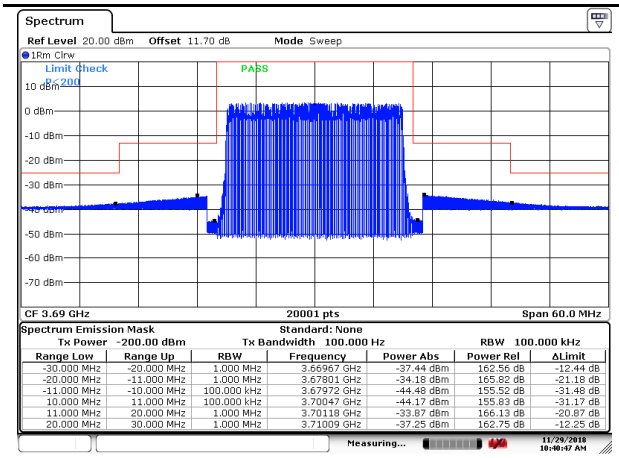


Figure 8.4-16: Emission mask measurements plot port 0, High channel (3690 MHz), 16QAM

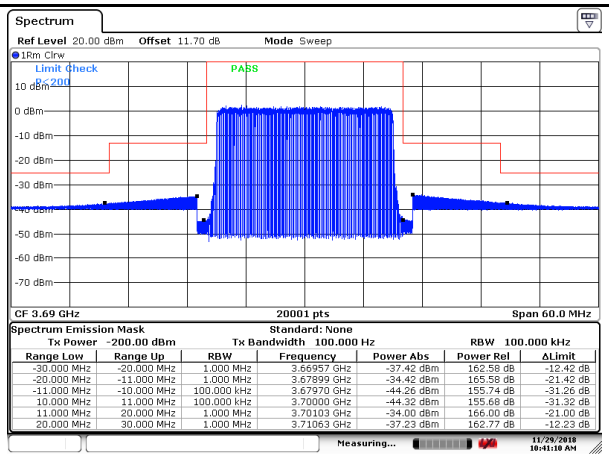


Figure 8.4-17: Emission mask measurements plot port 0, High channel (3690 MHz), 64QAM

8.4.6 Test data

Figures: Emission mask measurements for 20 MHz channel Port 0, Low, Mid and High Channel

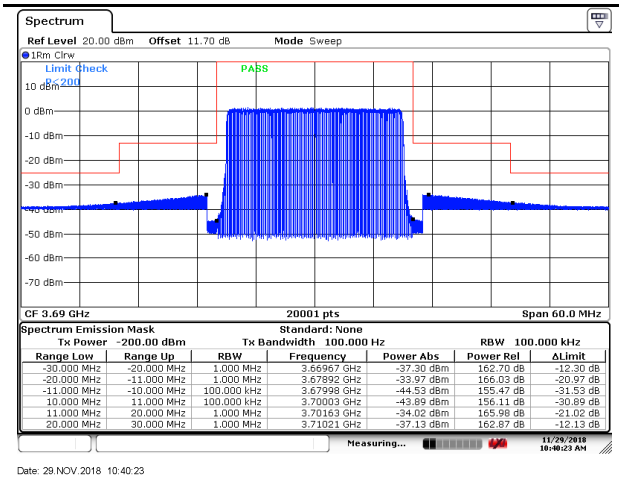


Figure 8.4-18: Emission mask measurements plot port 0, High channel (3690 MHz), QPSK

8.5 FCC 96.41(e)(2) Additional protection levels

8.5.1 Definitions and limits

The conducted power of any emissions below 3530 MHz or above 3720 MHz shall not exceed −40dBm/MHz.

8.5.2 Test summary

Verdict	Pass *see note below		
Test date	November 28, 2018	Temperature	22 °C
Test engineer	Martha Espinoza, EMC & Wireless Test Engineer	Air pressure	1001 mbar
Test location	Wireless Bench	Relative humidity	47 %

Spurious emissions compliance note: The closest spurious emission noted during conducted scans was at least 4dB below the required limit. Therefore when adding the Port 0 and Port 1 and additional 3dB has to be added. Adding the 3dB to the Port 0 plots below still still demonstrates compliance for the EUT.

8.5.3 Observations, settings and special notes

Spurious emissions were tested from 30 MHz to the 10th harmonic.
A 10 dB attenuator was used and a high pass filter (from the 7 to 18 GHz only) too for making all the measurements. The correction factor was applied properly in each case, for compensated the loss caused by those devices (conducted and radiated measurements).

Spectrum analyser settings:

Resolution bandwidth	100 kHz (radiated below 1 GHz) and 1 MHz (radiated above 1 GHz); 1 MHz (conducted)
Video bandwidth	3 × RBW
Detector and trace mode	RMS Power averaging (conducted), Peak Max-hold (radiated)

8.5.4 Test data

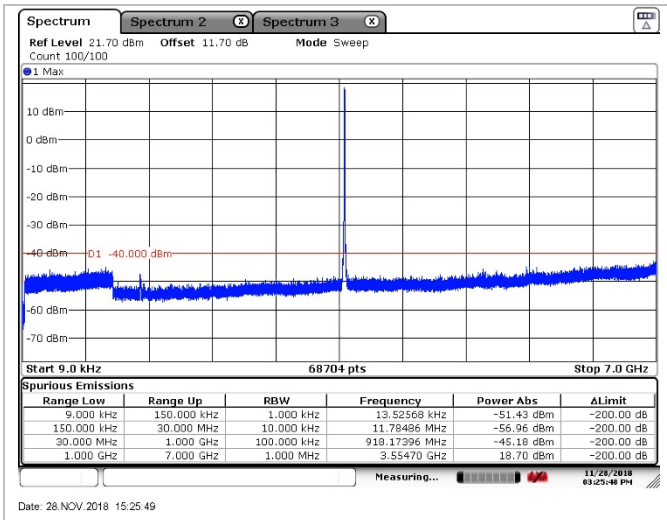


Figure 8.5-1: Conducted spurious graphic. Port 0, low channel (3555 MHz), 10 MHz BW. Frequency range from 9 KHZ to 7 GHz. 16QAM modulation

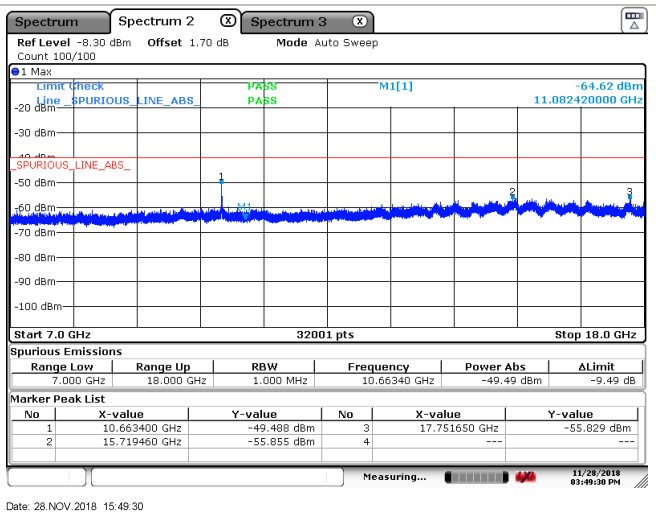


Figure 8.5-2: Conducted spurious graphic. Port 0, low channel (3555 MHz), 10 MHz BW. Frequency range from 7 GHz to 18 GHz. 16QAM modulation

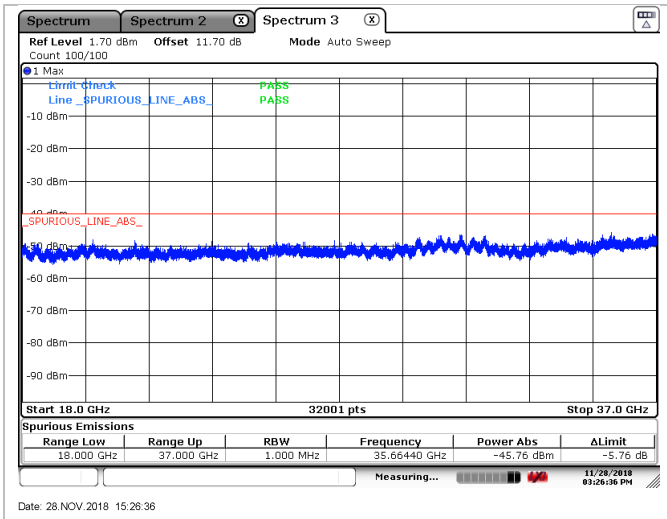


Figure 8.5-3: Conducted spurious graphic. Port 0, low channel (3555 MHz), 10 MHz BW. Frequency range from 18 GHz to 37 GHz. 16QAM modulation

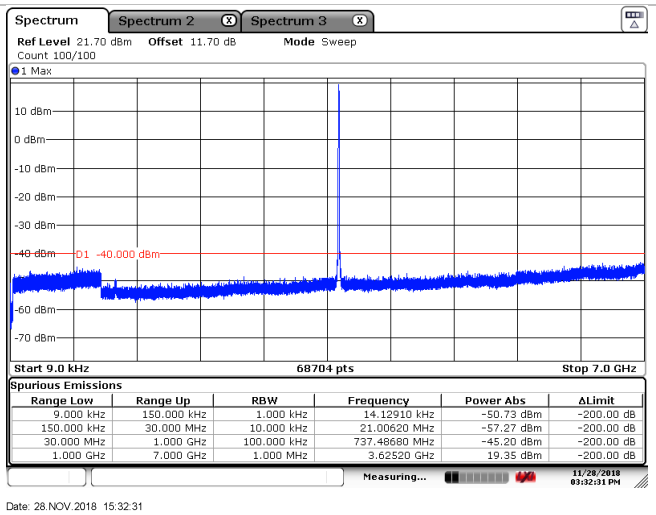


Figure 8.5-4: Conducted spurious graphic. Port 0, mid channel (3625 MHz), 10 MHz BW. Frequency range from 9 KHZ to 7 GHz. 16QAM modulation

8.5.4 Test data, continued

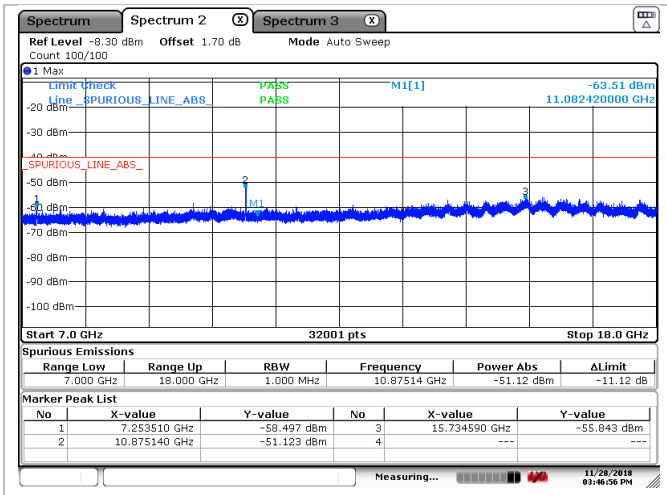


Figure 8.5-5: Conducted spurious graphic. Port 0, mid channel (3625 MHz), 10 MHz BW. Frequency range from 7 GHz to 18 GHz. 16QAM modulation

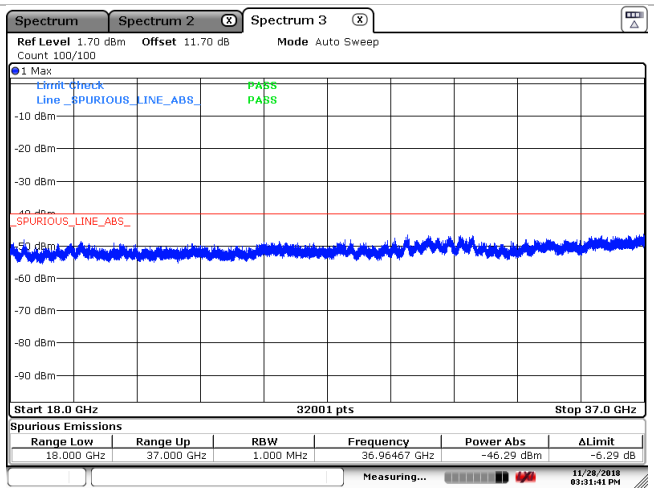


Figure 8.5-6: Conducted spurious graphic.Port 0, mid channel (3625 MHz), 10 MHz BW. Frequency range from 18 GHz to 37 GHz. 16QAM modulation

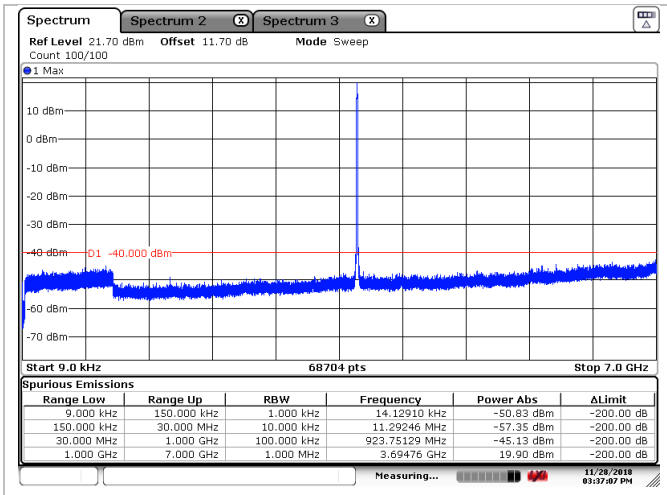


Figure 8.5-7: Conducted spurious graphic. Port 0, high channel (3695 MHz), 10 MHz BW. Frequency range from 9 KHZ to 7 GHz. 16QAM modulation

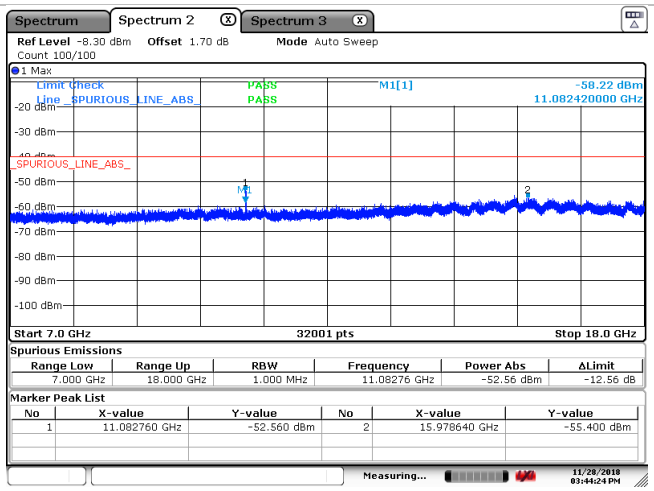


Figure 8.5-8: Conducted spurious graphic. Port 0, high channel (3695 MHz), 10 MHz BW. Frequency range from 7 GHz to 18 GHz. 16QAM modulation

8.5.4 Test data, continued

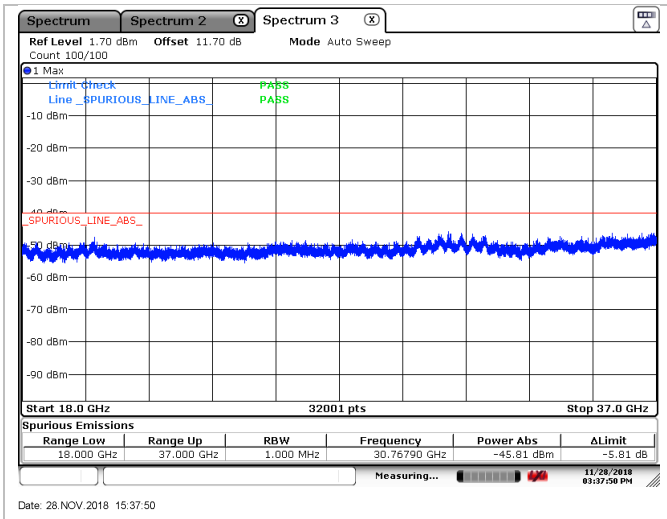


Figure 8.5-9: Conducted spurious graphic. Port 0, high channel (3695 MHz), 10 MHz BW. Frequency range from 18 GHz to 37 GHz. 16QAM modulation

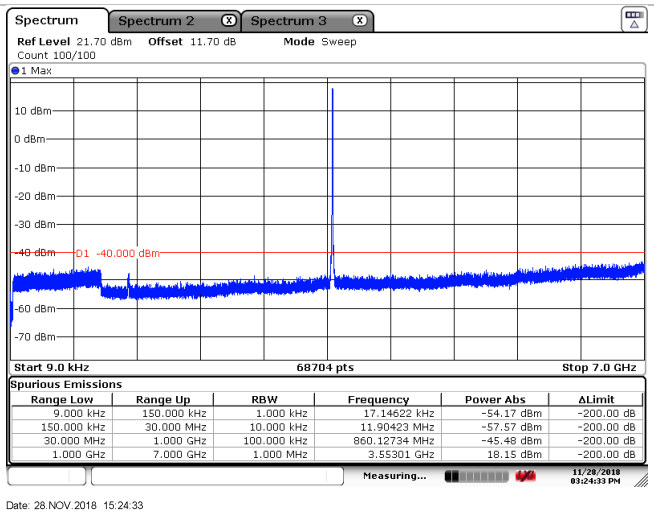


Figure 8.5-10: Conducted spurious graphic. Port 0, low channel (3560 MHz), 10 MHz BW. Frequency range from 9 KHZ to 7 GHz. QPSK modulation

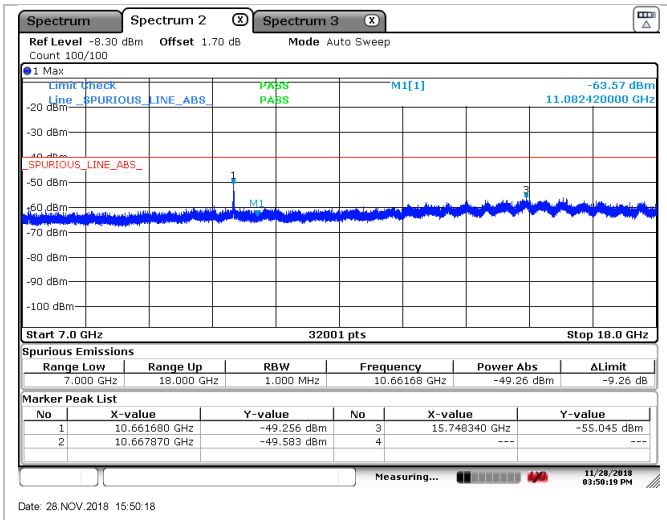


Figure 8.5-11: Conducted spurious graphic. Port 0, low channel (3560 MHz), 10 MHz BW. Frequency range from 7 GHz to 18 GHz. QPSK modulation

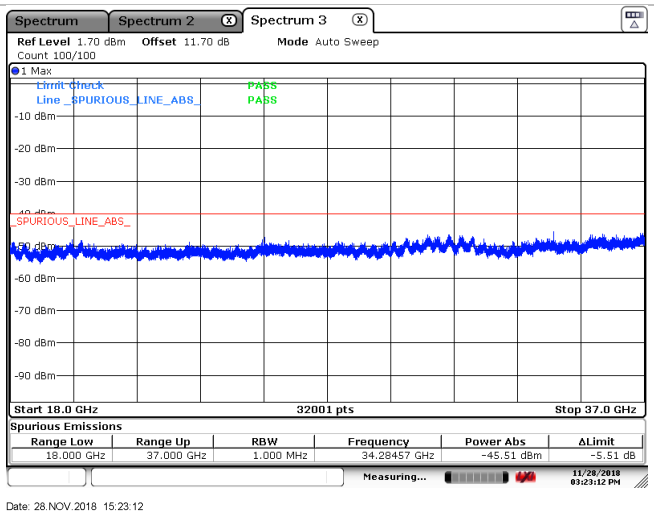


Figure 8.5-12: Conducted spurious graphic. Port 0, low channel (3560 MHz), 10 MHz BW. Frequency range from 18 GHz to 37 GHz. QPSK modulation

8.5.4 Test data, continued

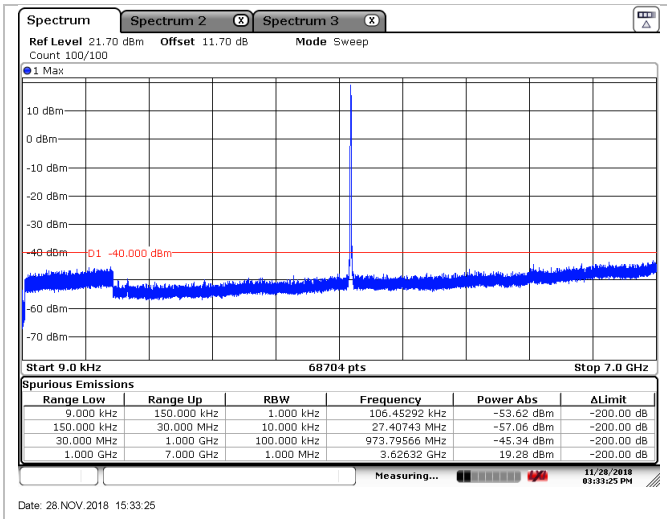


Figure 8.5-13: Conducted spurious graphic. Port 0, mid channel (3625 MHz), 10 MHz BW. Frequency range from 9 KHZ to 7 GHz. QPSK modulation

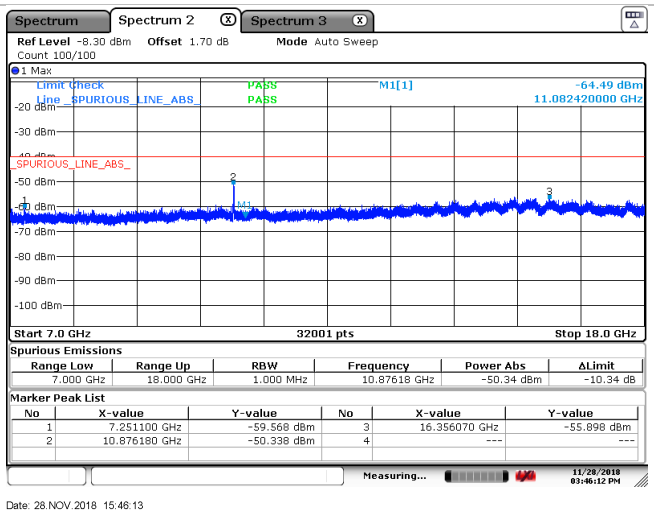


Figure 8.5-14: Conducted spurious graphic. Port 0, mid channel (3625 MHz), 10 MHz BW. Frequency range from 7 GHz to 18 GHz. QPSK modulation

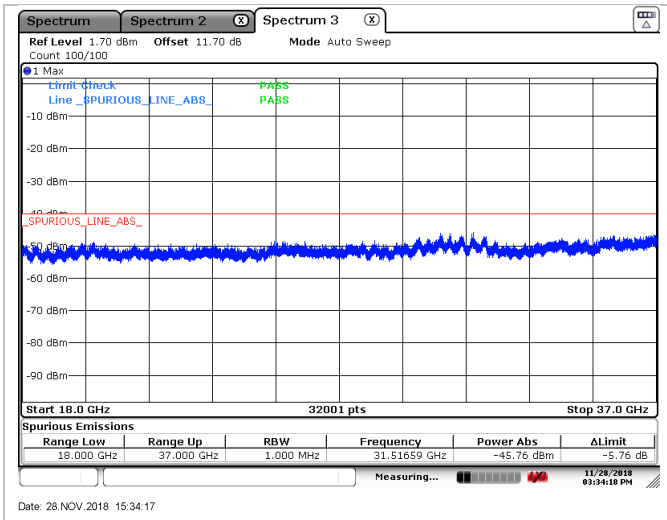


Figure 8.5-15: Conducted spurious graphic. Port 0, mid channel (3625 MHz), 10 MHz BW. Frequency range from 18 GHz to 37 GHz. QPSK modulation

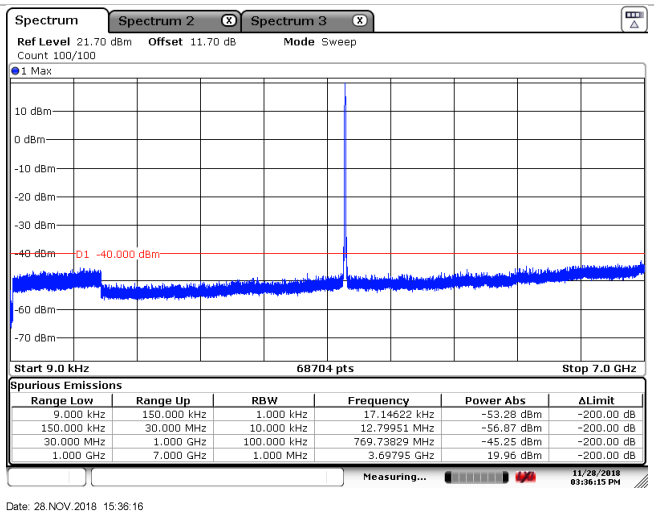


Figure 8.5-16: Conducted spurious graphic. Port 0, high channel (3690 MHz), 10 MHz BW. Frequency range from 9 KHZ to 7 GHz. QPSK modulation

8.5.4 Test data, continued

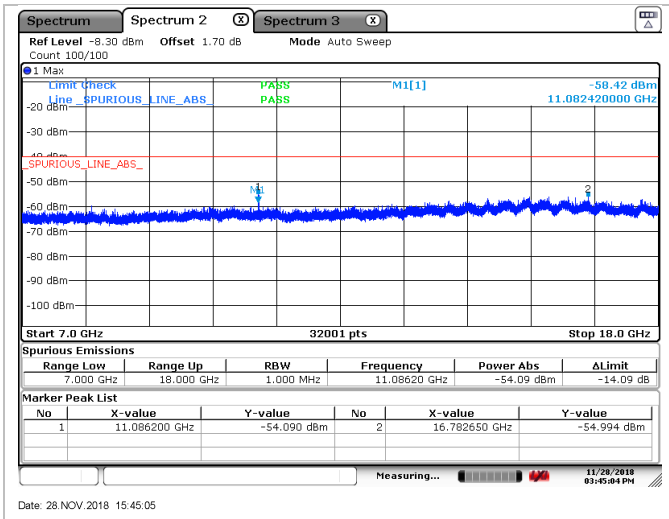


Figure 8.5-17: Conducted spurious graphic. Port 0, high channel (3690 MHz), 10 MHz BW. Frequency range from 7 GHz to 18 GHz. QPKS modulation

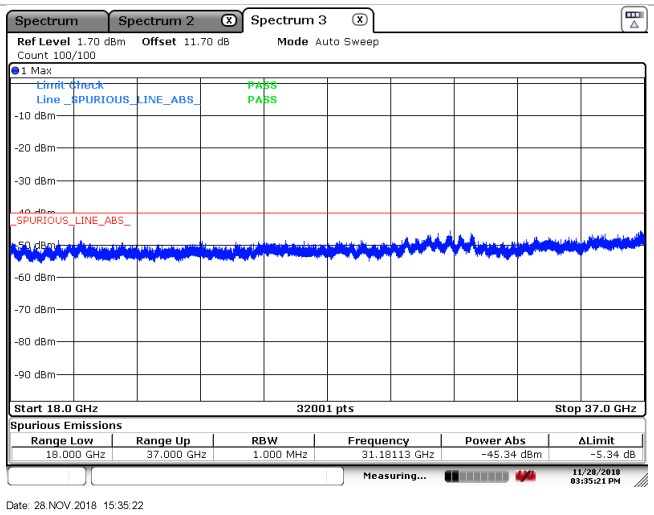


Figure 8.5-18: Conducted spurious graphic. Port 0, high channel (3690 MHz), 10 MHz BW. Frequency range from 18 GHz to 37 GHz. QPSK modulation

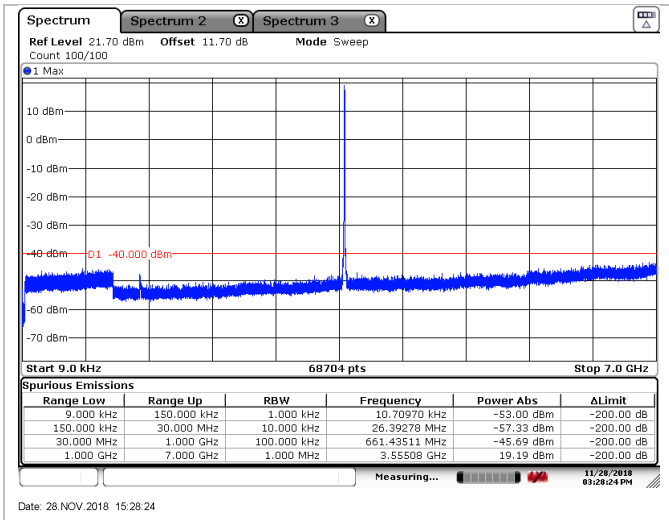


Figure 8.5-19: Conducted spurious graphic. Port 0, low channel (3555 MHz), 10 MHz BW. Frequency range from 9 KHZ to 7 GHz. 64QAM modulation

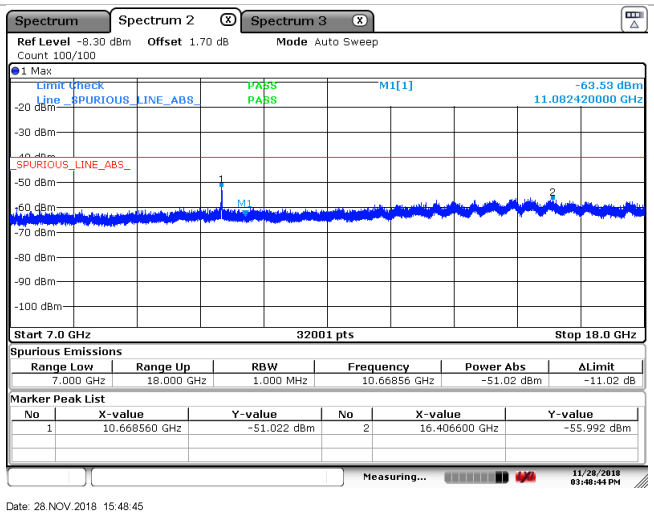


Figure 8.5-20: Conducted spurious graphic. Port 0, low channel (3555 MHz), 10 MHz BW. Frequency range from 7 GHz to 18 GHz. 64QAM modulation

8.5.4 Test data, continued

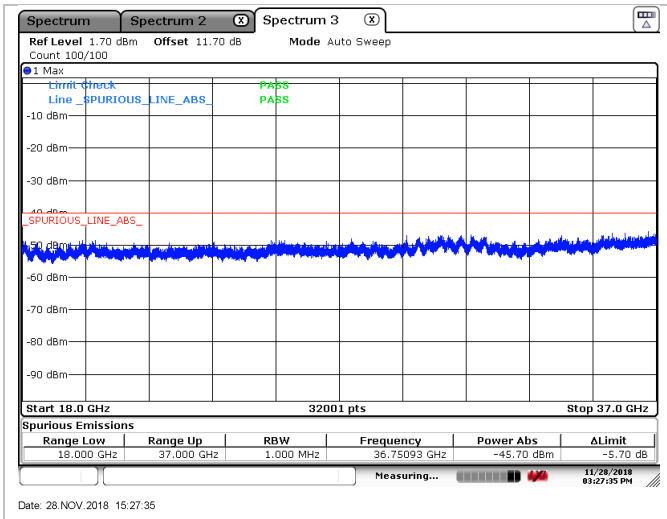


Figure 8.5-21: Conducted spurious graphic. Port 0, low channel (3555 MHz), 10 MHz BW. Frequency range from 18 GHz to 37 GHz. 64QAM modulation

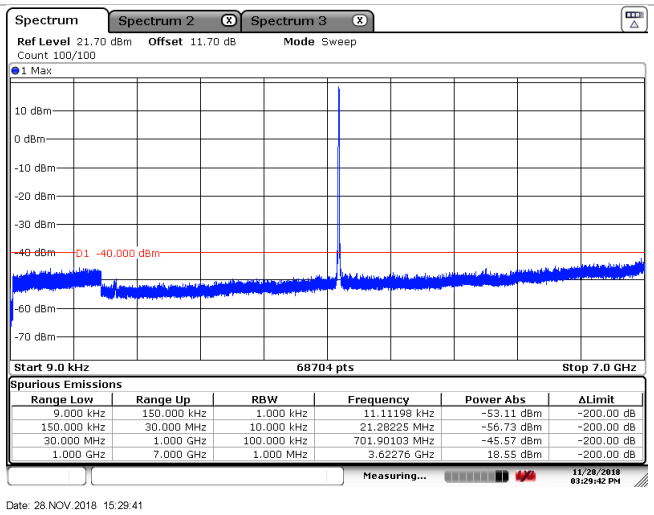


Figure 8.5-22: Conducted spurious graphic. Port 0, mid channel (3625 MHz), 10 MHz BW. Frequency range from 9 KHZ to 7 GHz. 64QAM modulation

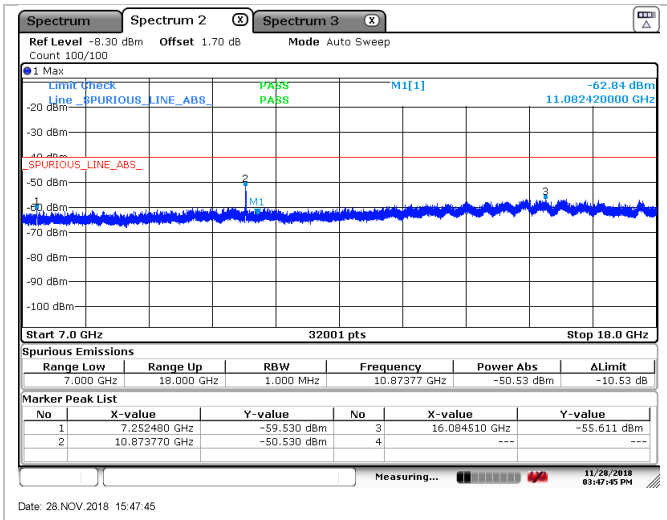


Figure 8.5-23: Conducted spurious graphic. Port 0, mid channel (3625 MHz), 10 MHz BW. Frequency range from 7 GHz to 18 GHz. 64QAM modulation

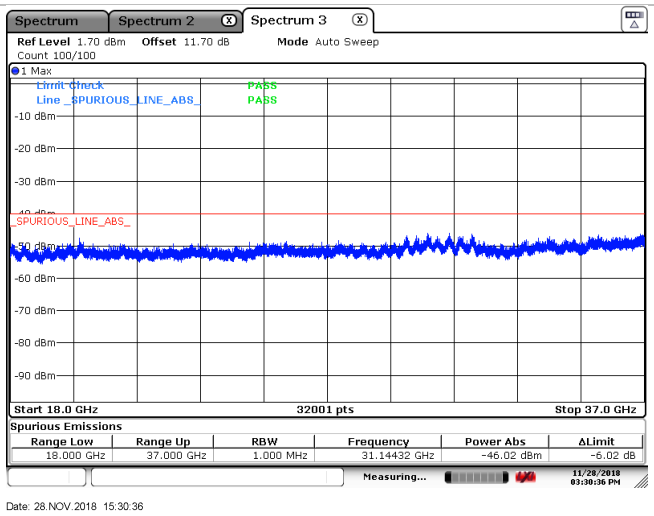


Figure 8.5-24: Conducted spurious graphic. Port 0, mid channel (3625 MHz), 10 MHz BW. Frequency range from 18 GHz to 37 GHz. 64QAM modulation

8.5.4 Test data, continued

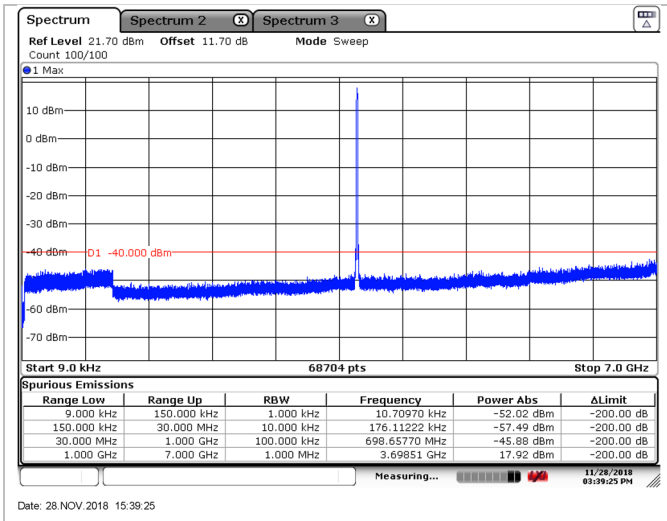


Figure 8.5-25: Conducted spurious graphic. Port 0, high channel (3695 MHz), 10 MHz BW. Frequency range from 9 KHZ to 7 GHz. 64QAM modulation

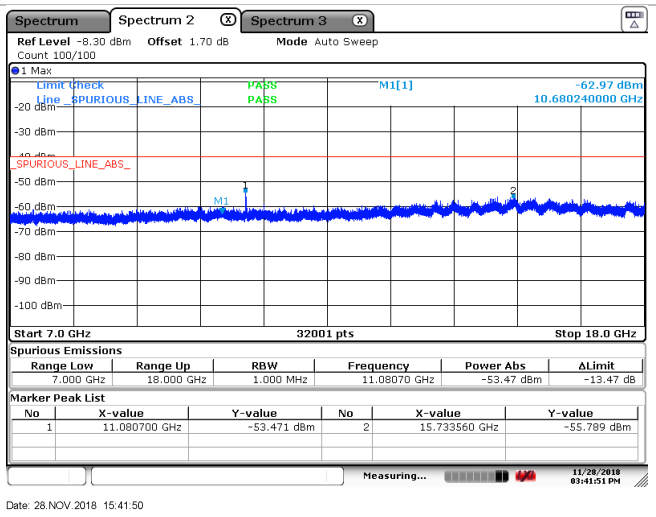


Figure 8.5-26: Conducted spurious graphic. Port 0, high channel (3695 MHz), 10 MHz BW. Frequency range from 7 GHz to 18 GHz. 64QAM modulation

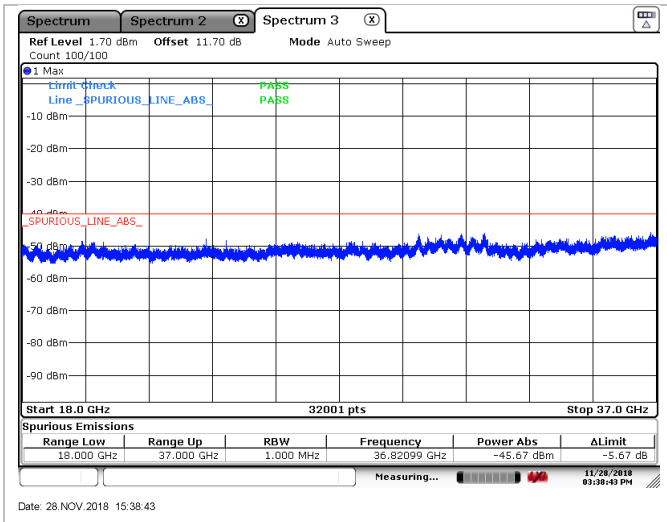


Figure 8.5-27: Conducted spurious graphic. Port 0, high channel (3695 MHz), 10 MHz BW. Frequency range from 18 GHz to 37 GHz. 64QAM modulation

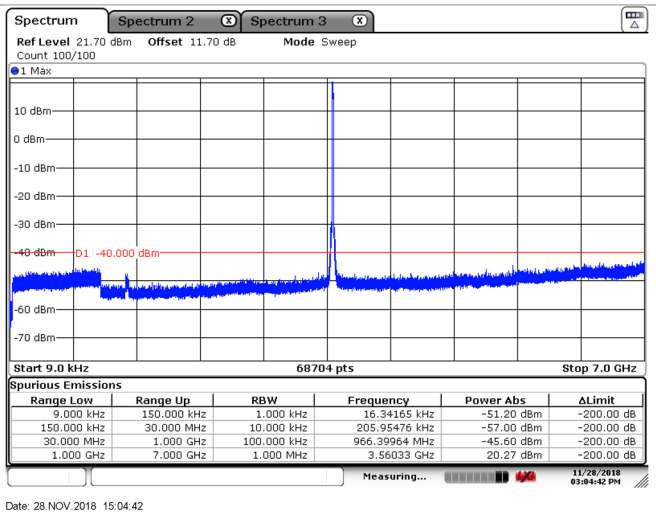
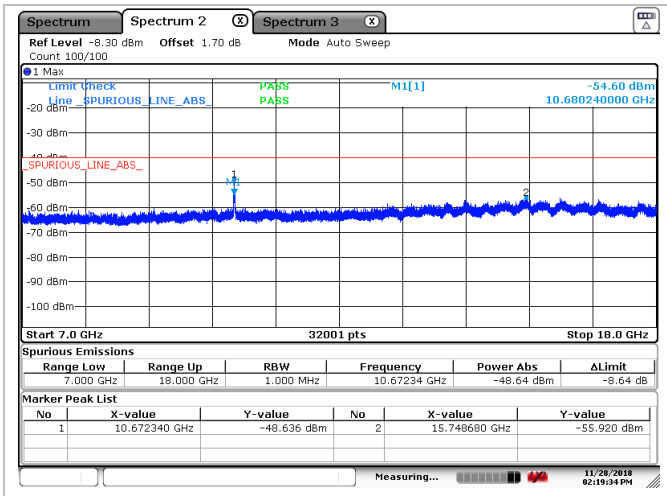


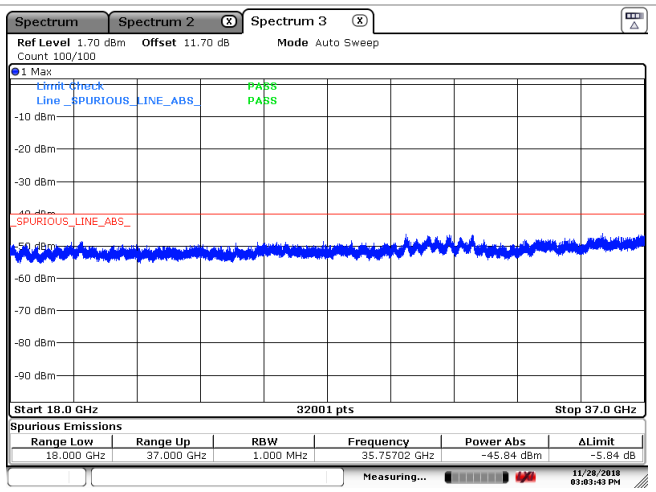
Figure 8.5-28: Conducted spurious graphic. Port 0, low channel (3560 MHz), 20 MHz BW. Frequency range from 9 KHZ to 7 GHz. 16QAM modulation

8.5.4 Test data, continued



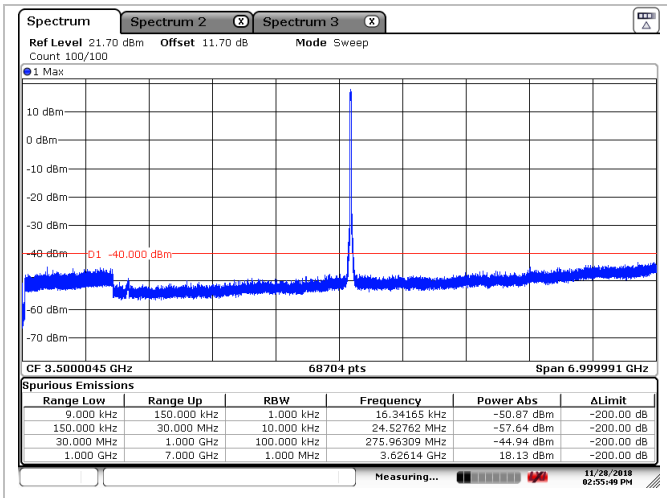
Date: 28.NOV.2018 14:19:34

Figure 8.5-29: Conducted spurious graphic. Port 0, low channel (3560 MHz), 20 MHz BW. Frequency range from 7 GHz to 18 GHz. 16QAM modulation



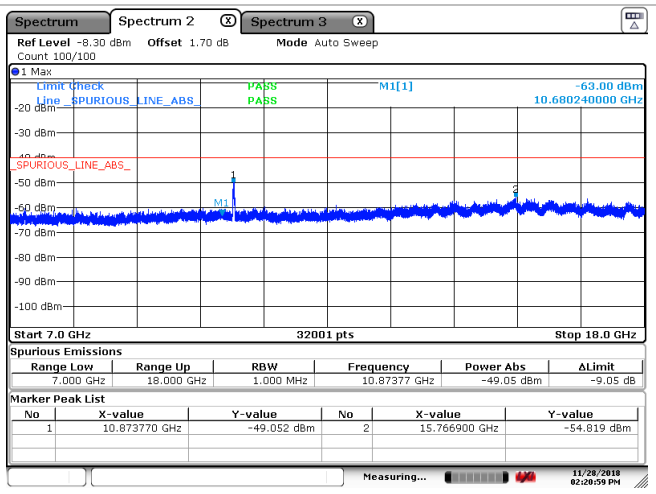
Date: 28.NOV.2018 15:03:43

Figure 8.5-30: Conducted spurious graphic. Port 0, low channel (3560 MHz), 20 MHz BW. Frequency range from 18 GHz to 37 GHz. 16QAM modulation



Date: 28.NOV.2018 14:55:49

Figure 8.5-31: Conducted spurious graphic. Port 0, mid channel (3625 MHz), 20 MHz BW. Frequency range from 9 KHZ to 7 GHz. 16QAM modulation



Date: 28.NOV.2018 14:20:59

Figure 8.5-32: Conducted spurious graphic. Port 0, mid channel (3625 MHz), 20 MHz BW. Frequency range from 7 GHz to 18 GHz. 16QAM modulation

8.5.4 Test data, continued

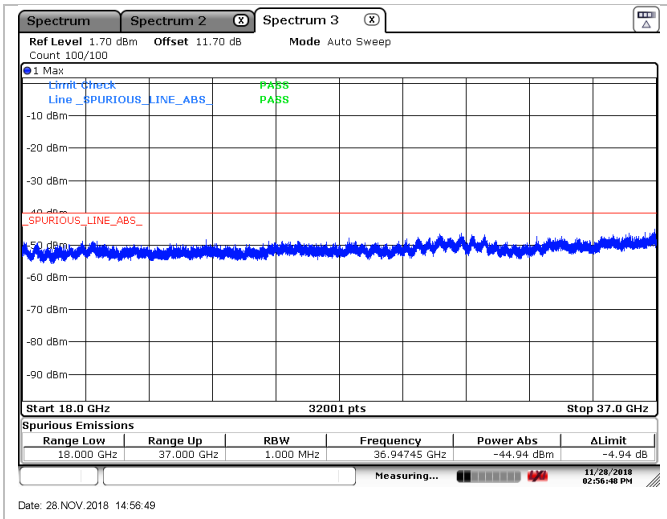


Figure 8.5-33: Conducted spurious graphic.Port 0, mid channel (3625 MHz), 20 MHz BW. Frequency range from 18 GHz to 37 GHz. 16QAM modulation

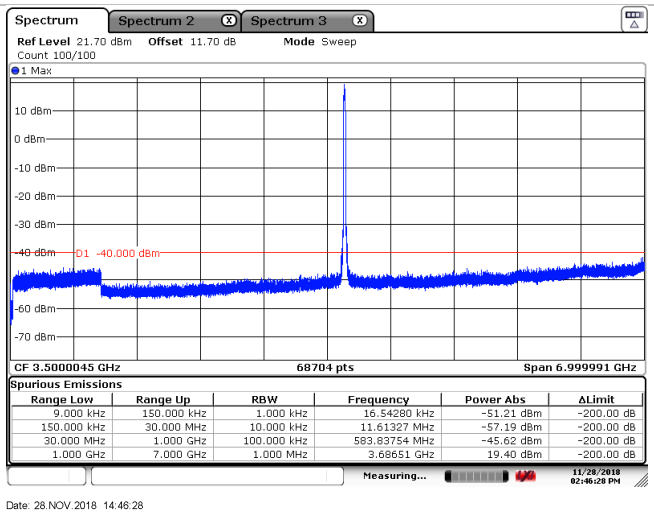


Figure 8.5-34: Conducted spurious graphic. Port 0, high channel (3690 MHz), 20 MHz BW. Frequency range from 9 KHZ to 7 GHz. 16QAM modulation

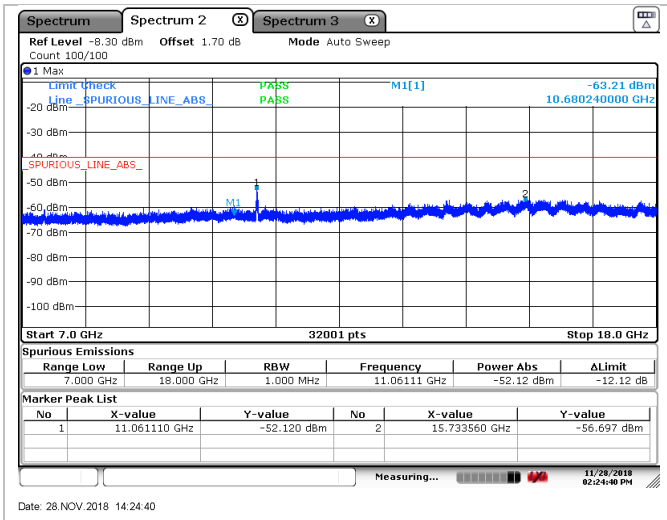


Figure 8.5-35: Conducted spurious graphic. Port 0, high channel (3690 MHz), 20 MHz BW. Frequency range from 7 GHz to 18 GHz. 16QAM modulation

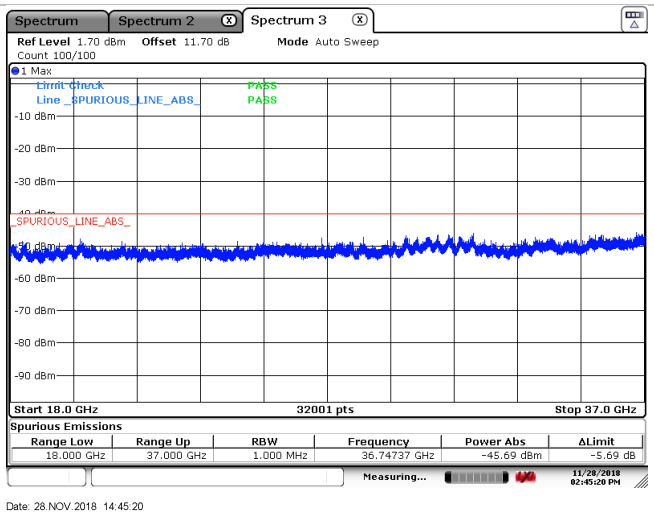


Figure 8.5-36: Conducted spurious graphic. Port 0, high channel (3690 MHz), 20 MHz BW. Frequency range from 18 GHz to 37 GHz. 16QAM modulation

8.5.4 Test data, continued

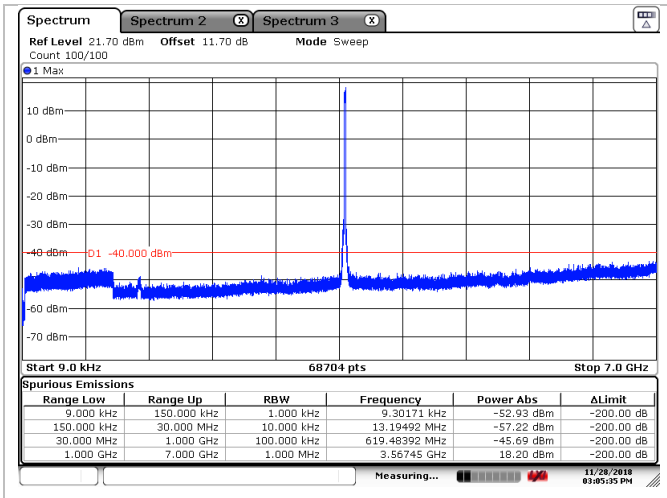


Figure 8.5-37: Conducted spurious graphic. Port 0, low channel (3560 MHz), 20 MHz BW. Frequency range from 9 KHZ to 7 GHz. QPSK modulation

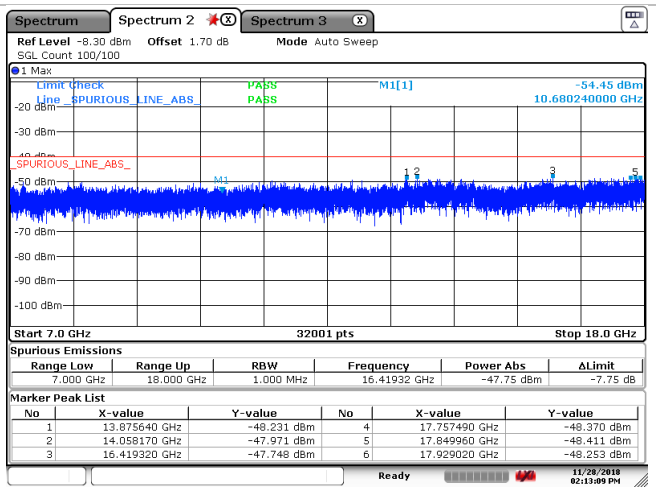


Figure 8.5-38: Conducted spurious graphic. Port 0, low channel (3560 MHz), 20 MHz BW. Frequency range from 7 GHz to 18 GHz. QPSK modulation

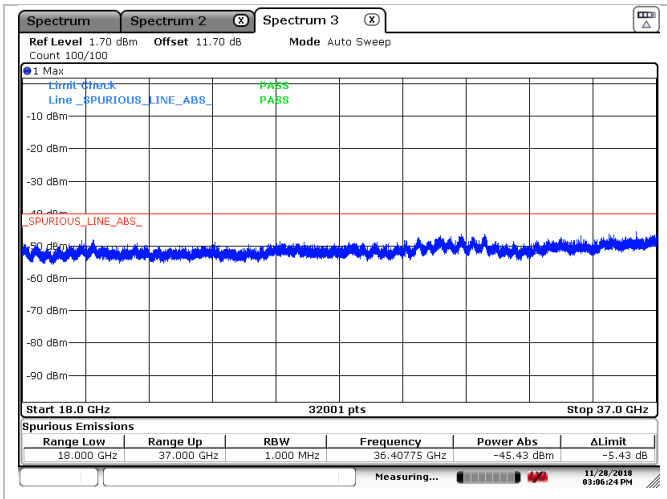


Figure 8.5-39: Conducted spurious graphic. Port 0, low channel (3560 MHz), 20 MHz BW. Frequency range from 18 GHz to 37 GHz. QPSK modulation

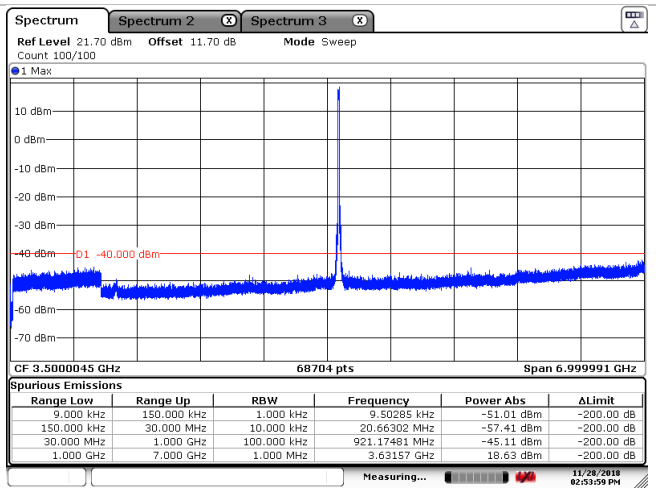


Figure 8.5-40: Conducted spurious graphic. Port 0, mid channel (3625 MHz), 20 MHz BW. Frequency range from 9 KHZ to 7 GHz. QPSK modulation

8.5.4 Test data, continued

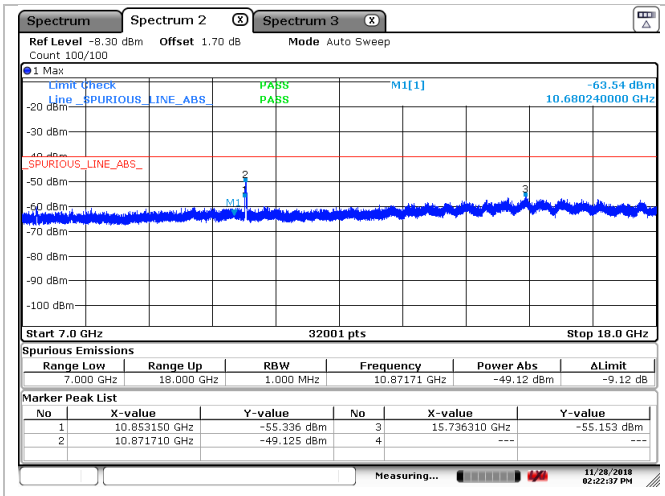


Figure 8.5-41: Conducted spurious graphic. Port 0, mid channel (3625 MHz), 20 MHz BW. Frequency range from 7 GHz to 18 GHz. QPSK modulation

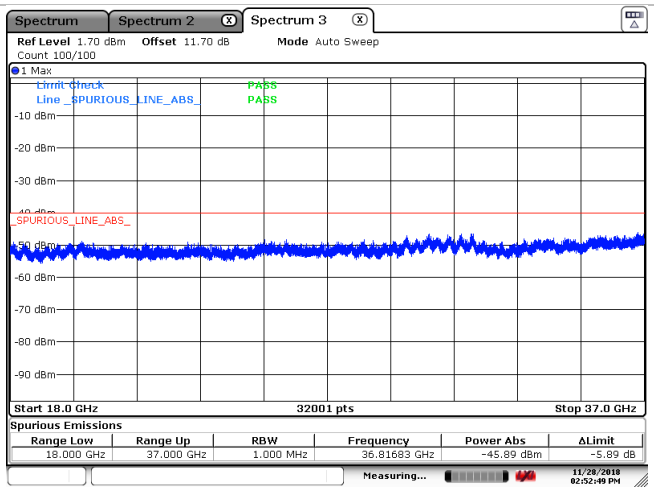


Figure 8.5-42: Conducted spurious graphic. Port 0, mid channel (3625 MHz), 20 MHz BW. Frequency range from 18 GHz to 37 GHz. QPSK modulation

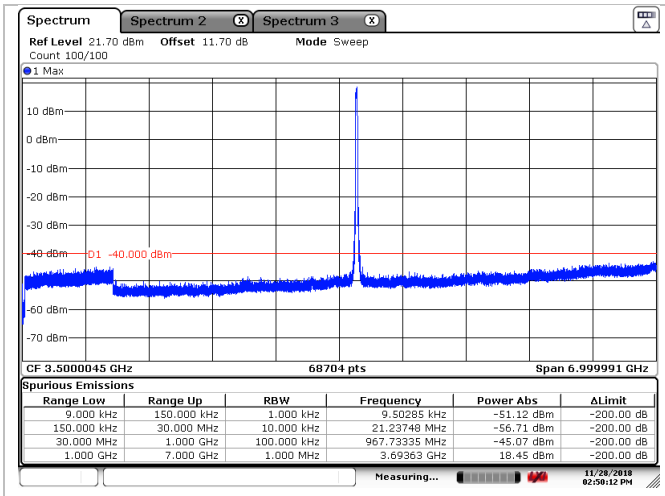


Figure 8.5-43: Conducted spurious graphic. Port 0, high channel (3690 MHz), 20 MHz BW. Frequency range from 9 KHZ to 7 GHz. QPSK modulation

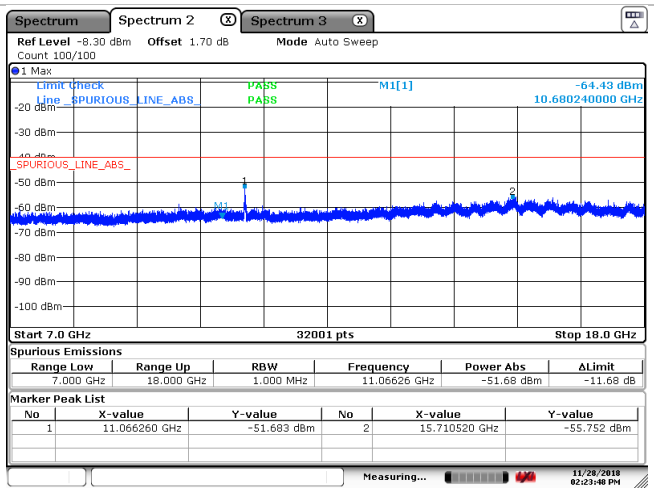


Figure 8.5-44: Conducted spurious graphic. Port 0, high channel (3690 MHz), 20 MHz BW. Frequency range from 7 GHz to 18 GHz. QPKS modulation

8.5.4 Test data, continued

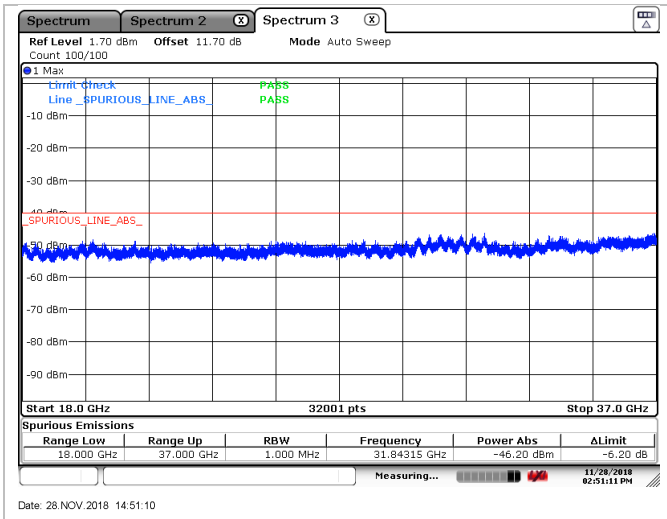


Figure 8.5-45: Conducted spurious graphic. Port 0, high channel (3690 MHz), 20 MHz BW. Frequency range from 18 GHz to 37 GHz. QPSK modulation

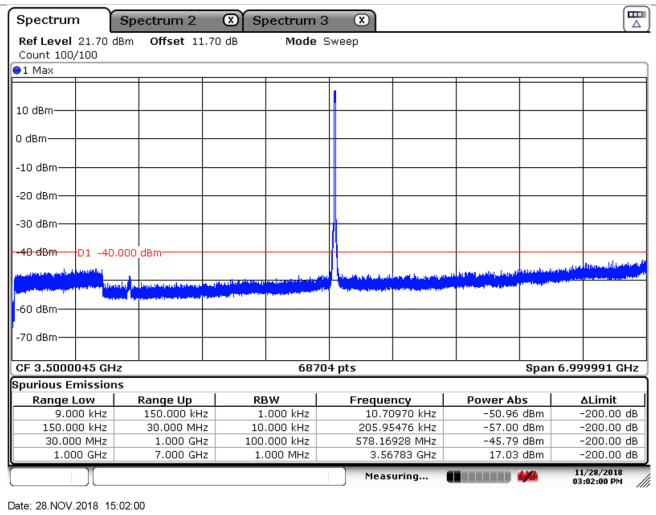


Figure 8.5-46: Conducted spurious graphic. Port 0, low channel (3560 MHz), 20 MHz BW. Frequency range from 9 KHZ to 7 GHz. 64QAM modulation

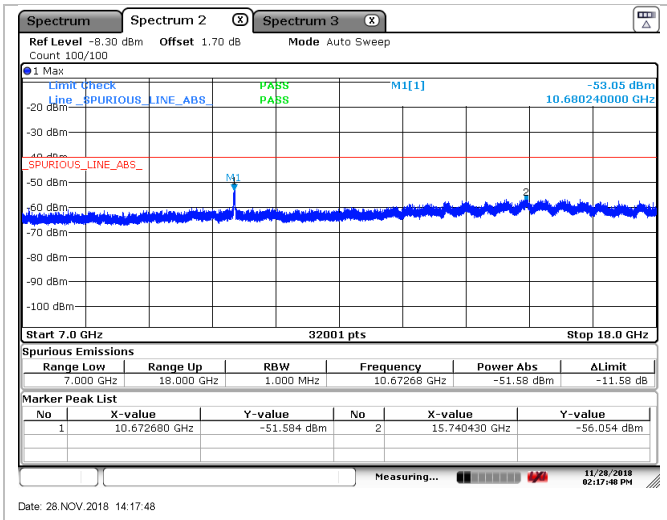


Figure 8.5-47: Conducted spurious graphic. Port 0, low channel (3560 MHz), 20 MHz BW. Frequency range from 7 GHz to 18 GHz. 64QAM modulation

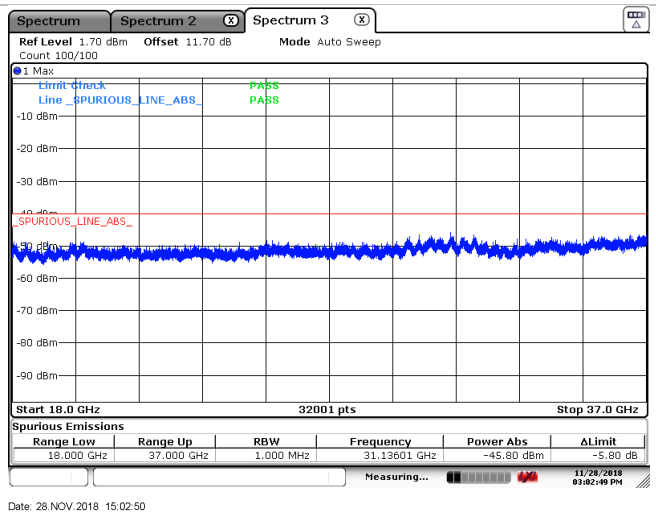


Figure 8.5-48: Conducted spurious graphic. Port 0, low channel (3560 MHz), 20 MHz BW. Frequency range from 18 GHz to 37 GHz. 64QAM modulation

8.5.4 Test data, continued

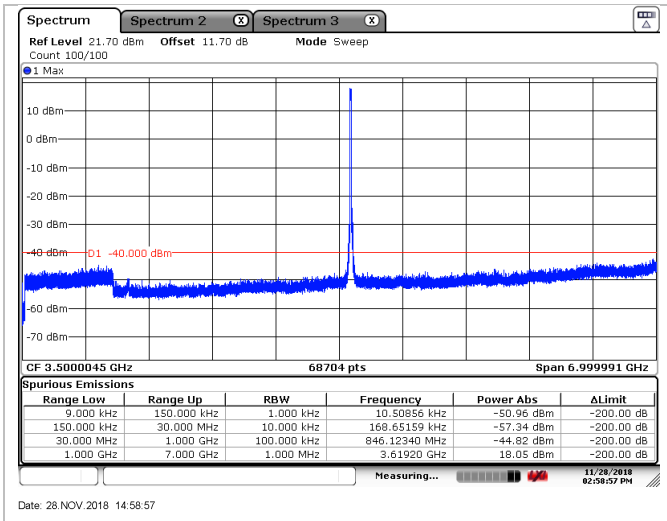


Figure 8.5-49: Conducted spurious graphic. Port 0, mid channel (3625 MHz), 20 MHz BW. Frequency range from 9 KHZ to 7 GHz. 64QAM modulation

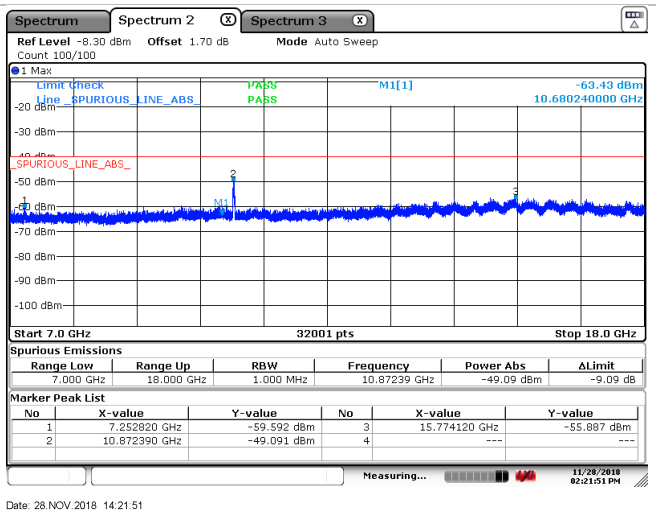


Figure 8.5-50: Conducted spurious graphic. Port 0, mid channel (3625 MHz), 20 MHz BW. Frequency range from 7 GHz to 18 GHz. 64QAM modulation

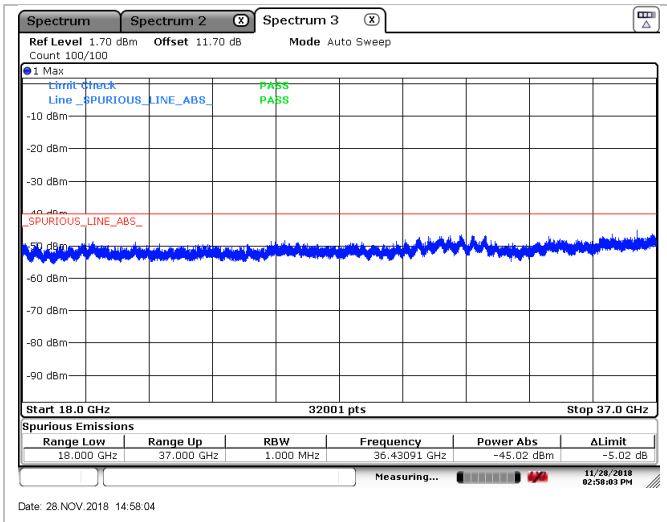


Figure 8.5-51: Conducted spurious graphic. Port 0, mid channel (3625 MHz), 20 MHz BW. Frequency range from 18 GHz to 37 GHz. 64QAM modulation

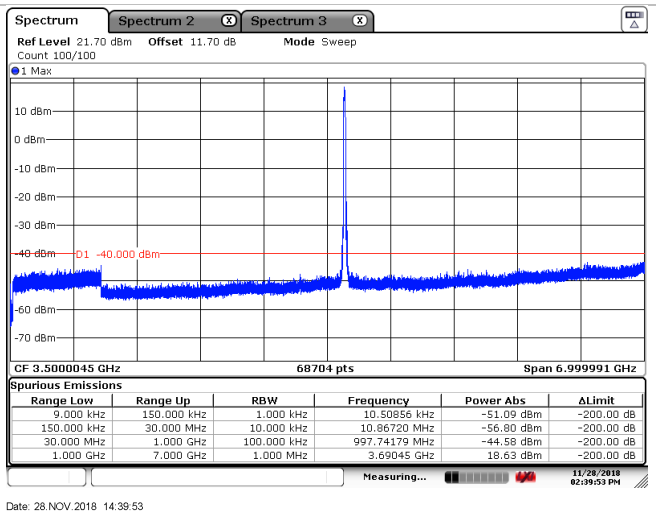


Figure 8.5-52: Conducted spurious graphic. Port 0, high channel (3690 MHz), 20 MHz BW. Frequency range from 9 KHZ to 7 GHz. 64QAM modulation

8.5.4 Test data, continued

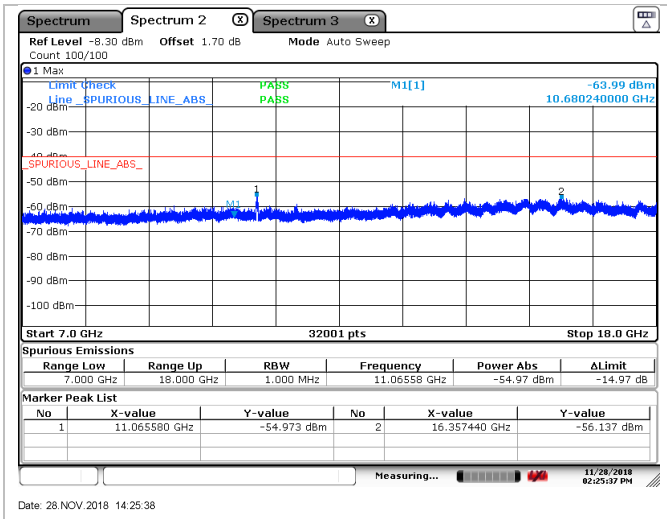


Figure 8.5-53: Conducted spurious graphic. Port 0, high channel (3690 MHz), 20 MHz BW. Frequency range from 7 GHz to 18 GHz. 64QAM modulation

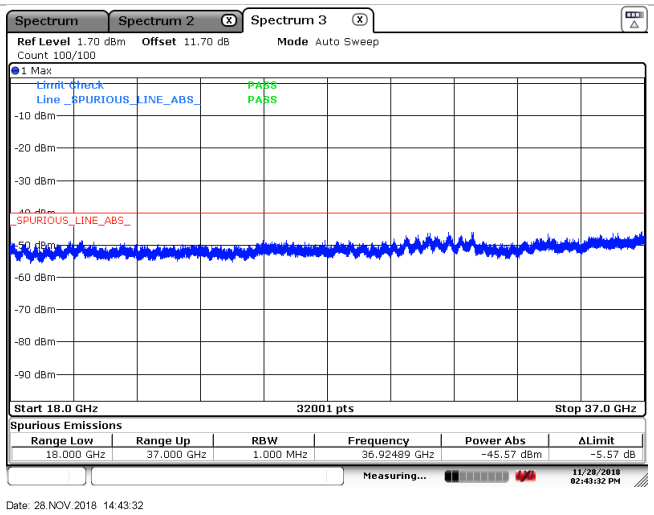


Figure 8.5-54: Conducted spurious graphic. Port 0, high channel (3690 MHz), 20 MHz BW. Frequency range from 18 GHz to 37 GHz. 64QAM modulation

8.5.4 Test data, continued (case radiated emissions)

For the radiated spurious measurements 16QAM modulation was chosen using the three channels with a bandwidth of 20 MHz. The measurements were done at 3 meters of distance and the results units are given in dbuv/m. The internal antennas were terminated with 50Ω attenuators during case radiation testing.

It is important to mention than frequency range from 1 to 18 GHz shows a fundamental transmission signal which looks has a higher value than FCC part 96 limit. However, that magnitude of the signal is not part of this test, thus, it can be ignored (this apply for all the cases).

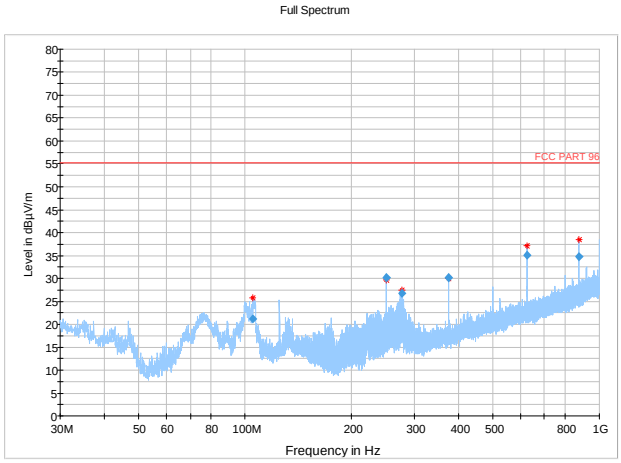


Figure 8.5-55: Radiated spurious graphic. Low channel (3560 MHz), 20 MHz BW, 16QAM Modulation. Frequency range from 30 MHz to 1 GHz

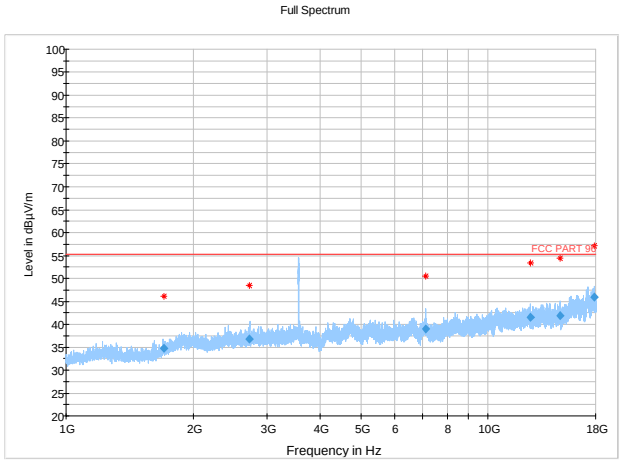


Figure 8.5-56: Radiated spurious graphic. Low channel (3560 MHz), 20 MHz BW, 16QAM Modulation. Frequency range from 1 GHz to 18 GHz

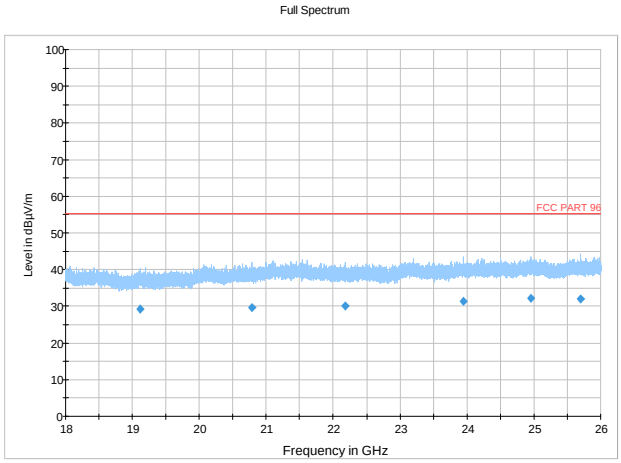


Figure 8.5-57: Radiated spurious graphic. Low channel (3560 MHz), 20 MHz BW, 16QAM Modulation. Frequency range from 18 GHz to 26 GHz

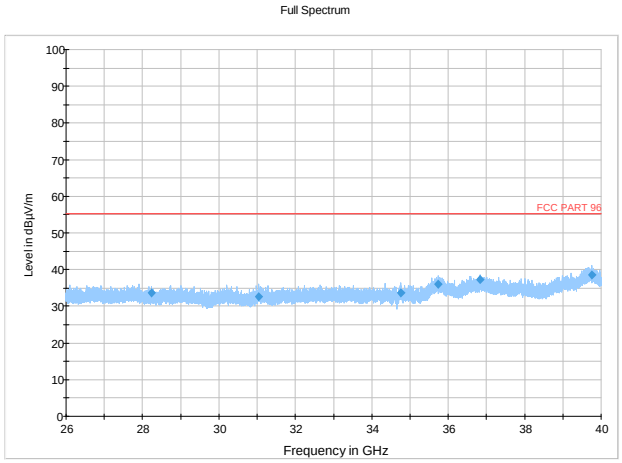


Figure 8.5-58: Radiated spurious graphic. Low channel (3560 MHz), 20 MHz BW, 16QAM Modulation. Frequency range from 26 GHz to 40 GHz

8.5.4 Test data, continued

Frequency (MHz)	QuasiPeak (dBµV/m)	Limit (dBµV/m)	Margin (dB)	Meas. Time (ms)	Bandwidth (kHz)	Height (cm)	Pol	Azimuth (deg)	Corr. (dB)
105.009500	21.16	55.23	34.07	5000.0	120.000	113.6	V	116.0	12.3
249.996000	30.15	55.23	25.08	5000.0	120.000	136.0	H	306.0	15.0
276.816500	26.84	55.23	28.39	5000.0	120.000	110.9	H	342.0	15.5
375.000500	30.25	55.23	24.98	5000.0	120.000	217.4	H	223.0	18.2
624.998000	35.17	55.23	20.06	5000.0	120.000	111.3	V	55.0	23.5
875.015500	34.82	55.23	20.41	5000.0	120.000	111.2	H	86.0	26.9

Table 8.5-1: Radiated spourious results. Low channel (3560 MHz), 20 MHz BW, 16QAM Modulation. Frequency range from 30 MHz to 1 GHz

Frequency (MHz)	RMS (dBµV/m)	Limit (dBµV/m)	Margin (dB)	Meas. Time (ms)	Bandwidth (kHz)	Height (cm)	Pol	Azimuth (deg)	Corr. (dB)
1707.800000	34.69	55.23	20.54	5000.0	1000.000	275.3	H	34.0	-2.6
2723.933333	36.85	55.23	18.38	5000.0	1000.000	219.0	H	64.0	1.3
7118.600000	39.06	55.23	16.17	5000.0	1000.000	402.7	V	64.0	10.0
12605.066667	41.61	55.23	13.62	5000.0	1000.000	137.3	V	159.0	15.7
14815.033333	41.83	55.23	13.40	5000.0	1000.000	180.7	V	85.0	18.2
17850.466667	45.98	55.23	9.25	5000.0	1000.000	210.8	V	237.0	23.2

Table 8.5-2: Radiated spurious graphic. Low channel (3560 MHz), 20 MHz BW, 16QAM Modulation. Frequency range from 1 GHz to 18 GHz

Frequency (MHz)	RMS (dBµV/m)	Limit (dBµV/m)	Margin (dB)	Meas. Time (ms)	Bandwidth (kHz)	Height (cm)	Pol	Azimuth (deg)	Corr. (dB)
19115.100000	29.34	55.23	25.89	5000.0	1000.000	107.5	H	272.0	0.9
20788.433333	29.63	55.23	25.60	5000.0	1000.000	100.0	H	-7.0	2.1
22175.233333	30.17	55.23	25.06	5000.0	1000.000	125.0	H	206.0	2.4
23946.700000	31.33	55.23	23.90	5000.0	1000.000	107.7	V	25.0	2.9
24951.900000	32.27	55.23	22.96	5000.0	1000.000	100.0	H	206.0	3.5
25695.100000	31.99	55.23	23.24	5000.0	1000.000	125.0	H	19.0	3.7

Table 8.5-3: Radiated spurious graphic. Low channel (3560 MHz), 20 MHz BW, 16QAM Modulation. Frequency range from 18 GHz to 26 GHz

Frequency (MHz)	RMS (dBµV/m)	Limit (dBµV/m)	Margin (dB)	Meas. Time (ms)	Bandwidth (kHz)	Height (cm)	Pol	Azimuth (deg)	Corr. (dB)
28228.566667	33.60	55.23	21.63	5000.0	1000.000	100.0	H	20.0	6.1
31044.833333	32.66	55.23	22.57	5000.0	1000.000	108.8	H	287.0	8.3
34751.900000	33.62	55.23	21.61	5000.0	1000.000	132.7	V	20.0	9.6
35737.900000	36.00	55.23	19.23	5000.0	1000.000	132.7	V	78.0	11.4
36836.033333	37.22	55.23	18.01	5000.0	1000.000	132.5	H	20.0	12.9
39763.100000	38.58	55.23	16.65	5000.0	1000.000	175.0	H	191.0	15.6

Figure 8.5-4: Radiated spurious graphic. Low channel (3560 MHz), 20 MHz BW, 16QAM Modulation. Frequency range from 26 GHz to 40 GHz

8.5.4 Test data, continued

.

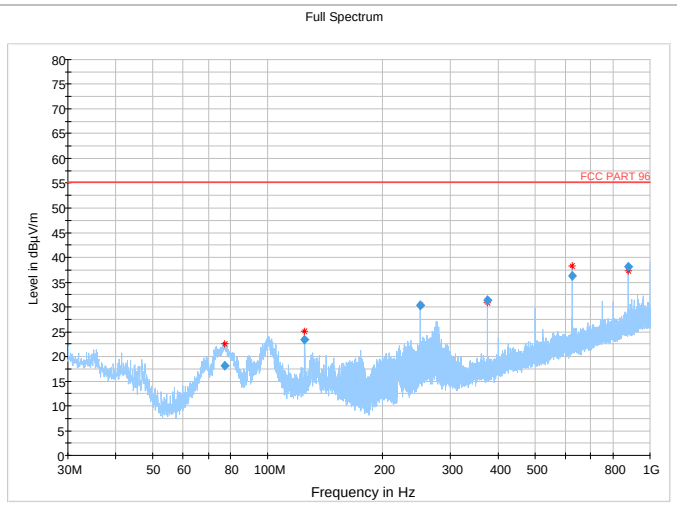


Figure 8.5-59: Radiated spurious graphic. Middle channel (3625 MHz), 20 MHz BW, QPSK Modulation. Frequency range from 30 MHz to 1 GHz

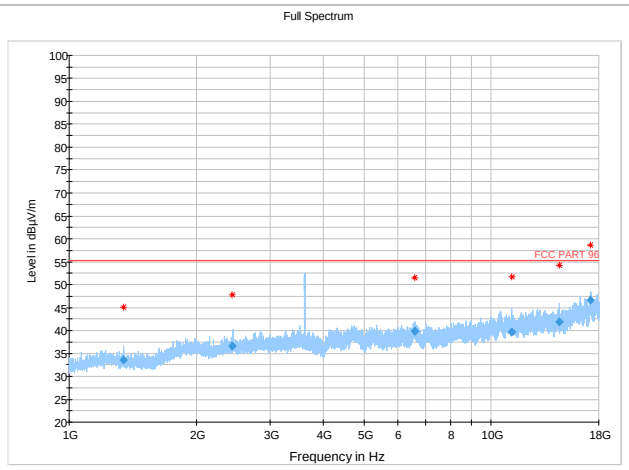


Figure 8.5-60: Radiated spurious graphic. Middle channel (3625 MHz), 20 MHz BW, QPSK Modulation. Frequency range from 1 GHz to 18 GHz

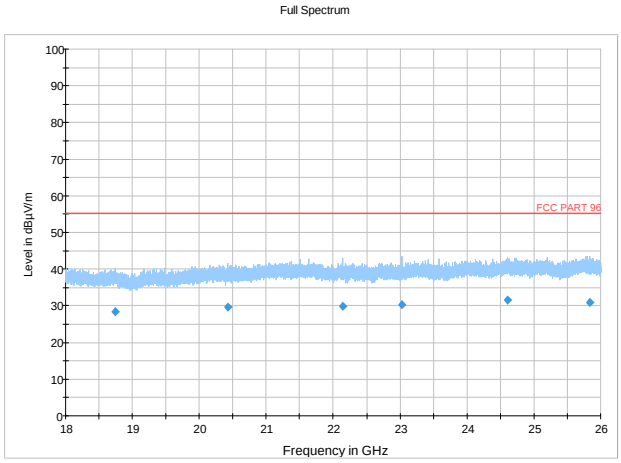


Figure 8.5-79: Radiated spurious graphic. Middle channel (3625 MHz), 20 MHz BW, 16QAM Modulation. Frequency range from 18 GHz to 26 GHz

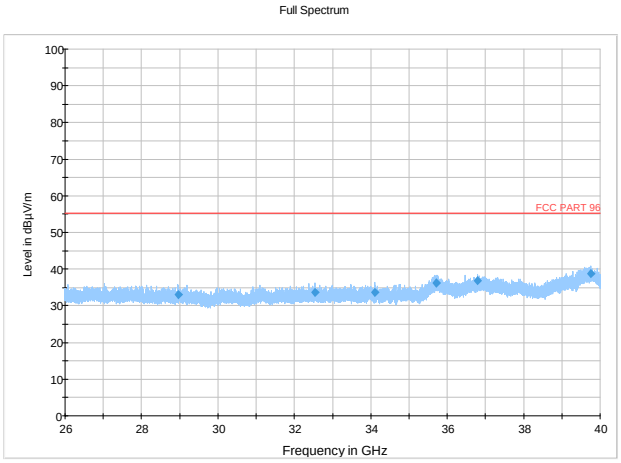


Figure 8.5-80: Radiated spurious graphic. Middle channel (3625 MHz), 20 MHz BW, 16QAM Modulation. Frequency range from 26 GHz to 40 GHz

8.5.4 Test data, continued

Frequency (MHz)	QuasiPeak (dBµV/m)	Limit (dBµV/m)	Margin (dB)	Meas. Time (ms)	Bandwidth (kHz)	Height (cm)	Pol	Azimuth (deg)	Corr. (dB)
77.005500	18.15	55.23	37.08	5000.0	120.000	312.2	H	0.0	8.8
125.011500	23.43	55.23	31.80	5000.0	120.000	388.4	H	326.0	13.6
249.996000	30.29	55.23	24.94	5000.0	120.000	111.3	H	298.0	15.0
375.000500	31.34	55.23	23.89	5000.0	120.000	217.9	H	206.0	18.2
624.998000	36.29	55.23	18.94	5000.0	120.000	111.3	V	354.0	23.5
875.004000	38.14	55.23	17.09	5000.0	120.000	100.1	H	72.0	26.9

Table 8.5-5: Radiated spourious results. Middle channel (3625 MHz), 20 MHz BW, 16QAM Modulation. Frequency range from 30 MHz to 1 GHz

Frequency (MHz)	RMS (dBµV/m)	Limit (dBµV/m)	Margin (dB)	Meas. Time (ms)	Bandwidth (kHz)	Height (cm)	Pol	Azimuth (deg)	Corr. (dB)
1347.333333	33.50	55.23	21.73	5000.0	1000.000	379.4	V	0.0	-4.0
2438.266667	36.58	55.23	18.65	5000.0	1000.000	245.9	H	0.0	0.5
6604.133333	39.85	55.23	15.38	5000.0	1000.000	118.1	V	335.0	10.2
11219.066667	39.65	55.23	15.58	5000.0	1000.000	328.0	H	357.0	12.9
14508.466667	41.86	55.23	13.37	5000.0	1000.000	397.5	V	251.0	18.1
17202.400000	46.67	55.23	8.56	5000.0	1000.000	98.0	H	354.0	22.3

Table 8.5-6: Radiated spurious graphic. Middle channel (3625 MHz), 20 MHz BW, QPSK Modulation. Frequency range from 1 GHz to 18 GHz

Frequency (MHz)	RMS (dBµV/m)	Limit (dBµV/m)	Margin (dB)	Meas. Time (ms)	Bandwidth (kHz)	Height (cm)	Pol	Azimuth (deg)	Corr. (dB)
18739.100000	28.47	55.23	26.76	5000.0	1000.000	175.0	H	177.0	0.7
20422.300000	29.71	55.23	25.52	5000.0	1000.000	107.5	H	231.0	2.3
22149.966667	29.92	55.23	25.31	5000.0	1000.000	100.0	V	198.0	2.4
23025.100000	30.34	55.23	24.89	5000.0	1000.000	125.0	V	346.0	2.5
24602.033333	31.55	55.23	23.68	5000.0	1000.000	175.0	H	312.0	3.1
25835.633333	31.01	55.23	24.22	5000.0	1000.000	109.4	V	312.0	3.7

Table 8.5-7: Radiated spurious graphic. Middle channel (3625 MHz), 20 MHz BW, 16QAM Modulation. Frequency range from 18 GHz to 26 GHz

Frequency (MHz)	RMS (dBµV/m)	Limit (dBµV/m)	Margin (dB)	Meas. Time (ms)	Bandwidth (kHz)	Height (cm)	Pol	Azimuth (deg)	Corr. (dB)
28956.900000	33.10	55.23	22.13	5000.0	1000.000	162.7	H	23.0	6.5
32541.766667	33.79	55.23	21.44	5000.0	1000.000	100.0	H	145.0	8.3
34102.500000	33.69	55.23	21.54	5000.0	1000.000	109.0	H	27.0	9.1
35705.300000	36.17	55.23	19.06	5000.0	1000.000	107.3	H	20.0	11.3
36799.566667	36.87	55.23	18.36	5000.0	1000.000	125.0	H	-7.0	12.8
39746.433333	38.67	55.23	16.56	5000.0	1000.000	100.0	V	-7.0	15.6

Figure 8.5-8: Radiated spurious graphic. Middle channel (3625 MHz), 20 MHz BW, 16QAM Modulation. Frequency range from 26 GHz to 40 GHz

8.5.4 Test data, continued

.

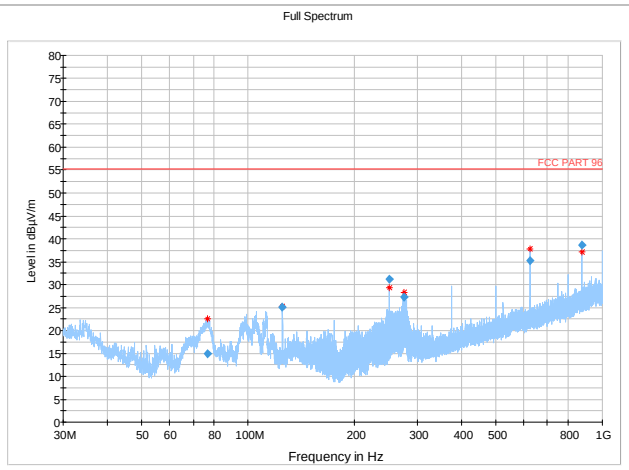


Figure 8.5-81: Radiated spurious graphic. High channel (3690 MHz), 20 MHz BW, 16QAM Modulation. Frequency range from 30 MHz to 1 GHz

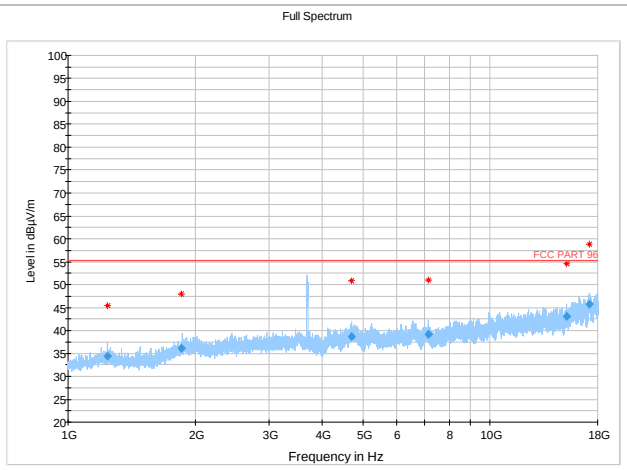


Figure 8.5-82: Radiated spurious graphic. High channel (3690 MHz), 20 MHz BW, 16QAM Modulation. Frequency range from 1 GHz to 18 GHz

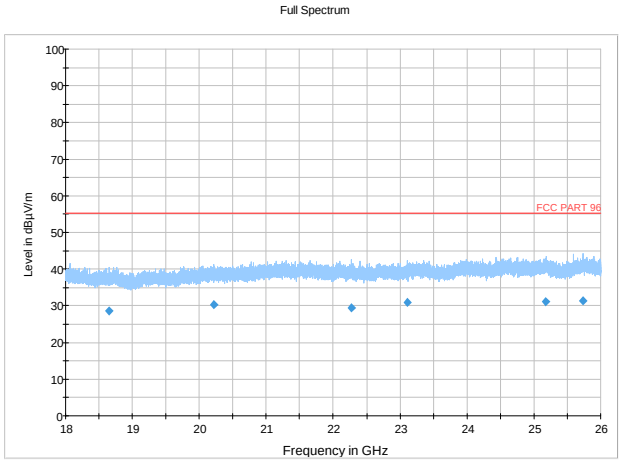


Figure 8.5-83: Radiated spurious graphic. High channel (3690 MHz), 20 MHz BW, 16QAM Modulation. Frequency range from 18 GHz to 26 GHz

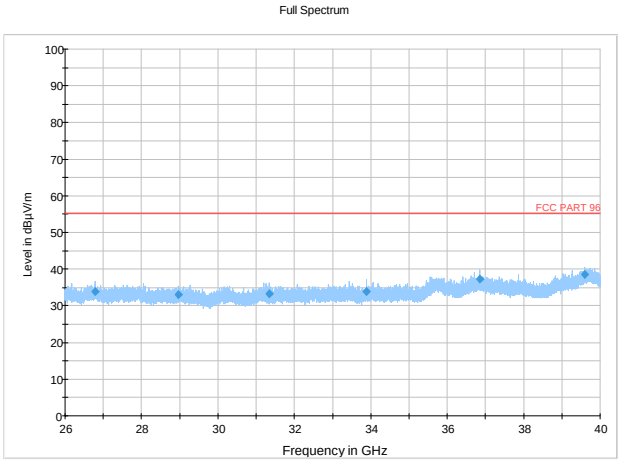


Figure 8.5-84: Radiated spurious graphic. High channel (3690 MHz), 20 MHz BW, 16QAM Modulation. Frequency range from 26 GHz to 40 GHz

8.5.4 Test data, continued

Frequency (MHz)	QuasiPeak (dBµV/m)	Limit (dBµV/m)	Margin (dB)	Meas. Time (ms)	Bandwidth (kHz)	Height (cm)	Pol	Azimuth (deg)	Corr. (dB)
76.961500	15.00	55.23	40.23	5000.0	120.000	396.2	H	157.0	8.7
125.003000	25.14	55.23	30.09	5000.0	120.000	289.0	H	315.0	13.6
250.016000	31.23	55.23	24.00	5000.0	120.000	134.1	H	280.0	15.0
275.356500	27.34	55.23	27.89	5000.0	120.000	111.1	H	325.0	15.5
625.018000	35.32	55.23	19.91	5000.0	120.000	111.2	V	283.0	23.5
874.995500	38.67	55.23	16.56	5000.0	120.000	125.1	V	0.0	26.9

Table 8.5-9: Radiated spourious results. High channel (3690 MHz), 20 MHz BW, QPSK Modulation. Frequency range from 30 MHz to 1 GHz

Frequency (MHz)	RMS (dBµV/m)	Limit (dBµV/m)	Margin (dB)	Meas. Time (ms)	Bandwidth (kHz)	Height (cm)	Pol	Azimuth (deg)	Corr. (dB)
1240.300000	34.45	55.23	20.78	5000.0	1000.000	116.0	V	124.0	-3.5
1855.700000	36.16	55.23	19.07	5000.0	1000.000	271.7	H	16.0	-1.2
4704.700000	38.72	55.23	16.51	5000.0	1000.000	381.7	H	0.0	8.0
7157.533333	39.10	55.23	16.13	5000.0	1000.000	191.5	V	357.0	10.0
15188.500000	43.02	55.23	12.21	5000.0	1000.000	179.7	H	250.0	17.9
17212.766667	45.72	55.23	9.51	5000.0	1000.000	219.1	H	0.0	22.2

Table 8.5-10: Radiated spurious graphic. High channel (3690 MHz), 20 MHz BW, QPSK Modulation. Frequency range from 1 GHz to 18 GHz

Frequency (MHz)	RMS (dBµV/m)	Limit (dBµV/m)	Margin (dB)	Meas. Time (ms)	Bandwidth (kHz)	Height (cm)	Pol	Azimuth (deg)	Corr. (dB)
18655.100000	28.59	55.23	26.64	5000.0	1000.000	100.0	H	24.0	0.8
20217.500000	30.22	55.23	25.01	5000.0	1000.000	100.0	V	313.0	2.2
22275.900000	29.47	55.23	25.76	5000.0	1000.000	107.7	H	17.0	2.4
23114.233333	30.84	55.23	24.39	5000.0	1000.000	107.6	H	131.0	2.5
25180.566667	31.13	55.23	24.10	5000.0	1000.000	100.0	H	175.0	3.1
25733.633333	31.45	55.23	23.78	5000.0	1000.000	107.6	V	271.0	3.8

Table 8.5-11: Radiated spurious graphic. High channel (3690 MHz), 20 MHz BW, 16QAM Modulation. Frequency range from 18 GHz to 26 GHz

Frequency (MHz)	RMS (dBµV/m)	Limit (dBµV/m)	Margin (dB)	Meas. Time (ms)	Bandwidth (kHz)	Height (cm)	Pol	Azimuth (deg)	Corr. (dB)
26796.100000	33.86	55.23	21.37	5000.0	1000.000	99.9	H	261.0	5.5
28967.100000	33.01	55.23	22.22	5000.0	1000.000	100.0	V	46.0	6.5
31339.233333	33.17	55.23	22.06	5000.0	1000.000	100.0	H	23.0	8.4
33891.900000	33.89	55.23	21.34	5000.0	1000.000	139.1	H	26.0	8.9
36851.500000	37.31	55.23	17.92	5000.0	1000.000	175.0	H	312.0	13.0
39595.233333	38.53	55.23	16.70	5000.0	1000.000	100.0	V	92.0	15.6

Figure 8.5-12: Radiated spurious graphic. High channel (3690 MHz), 20 MHz BW, 16QAM Modulation. Frequency range from 26 GHz to 40 GHz

8.6 FCC 2.1055 Frequency stability

8.6.1 Definitions and limits

(a) The frequency stability shall be measured with variation of ambient temperature as follows:
(1) From −30°C to +50°C for all equipment except that specified in paragraphs (a)(2) and (3) of this section
(b) Frequency measurements shall be made at the extremes of the specified temperature range and at intervals of not more than 10° C through the range.
(d) The frequency stability shall be measured with variation of primary supply voltage as follows:
(1) Vary primary supply voltage from 85 to 115 percent of the nominal value for other than hand carried battery equipment.

8.6.2 Test summary

Verdict	Pass		
Test date	December 11, 2018	Temperature	22 °C
Test engineer	Martha Espinoza, EMC & Wireless Test Engineer	Air pressure	1005 mbar
Test location	Wireless Bench	Relative humidity	55 %

8.6.3 Observations, settings and special notes

For this testing, only the port three was measured using 20 MHz of bandwith and the three channels for each selected temperature. Also, a voltage variation measurements is included at room temperature (20°C)

Spectrum analyser settings:

Resolution bandwidth	≥ 1 % of emission bandwidth
Video bandwidth	≥ 3 × RBW
Frequency span	Wider than emission bandwidth
Detector mode	Peak

8.6.1 Test data

Table 8.6-1: Frequency drift measurement results, low channel (3560 MHz)

Test conditions	Frequency, MHz	Offset, ppm
+50 °C, Nominal	3559.984	-6.742
+40 °C, Nominal	3559.967	1.966
+30 °C, Nominal	3559.987	7.584
+20 °C, Nominal	**3559.960**	Reference
+10 °C, Nominal	3560.014	-15.169
0 °C, Nominal	3560.034	20.787
−10 °C, Nominal	3560.039	**22.191**
−20 °C, Nominal	3560.009	-13.764
−30 °C, Nominal	3560.006	-12.921

Table 8.6-2: Frequency drift measurement results, voltage variation, low channel (3560 MHz).

Test conditions	Frequency, MHz	Offset, ppm
+20 °C, +15 %	3560.014	15.169
+20 °C	**3559.960**	Reference
+20 °C, -15 %	3559.980	5.618

Table 8.6-3: Frequency drift measurement results, voltage variation, middle channel (3625 MHz).

Test conditions	Frequency, MHz	Offset, ppm
+20 °C, +15 %	3624.987	0.000
+20 °C	**3624.987**	Reference
+20 °C, -15 %	3625.000	3.586

Table 8.6-4: Frequency drift measurement results, voltage variation, high channel (3690 MHz).

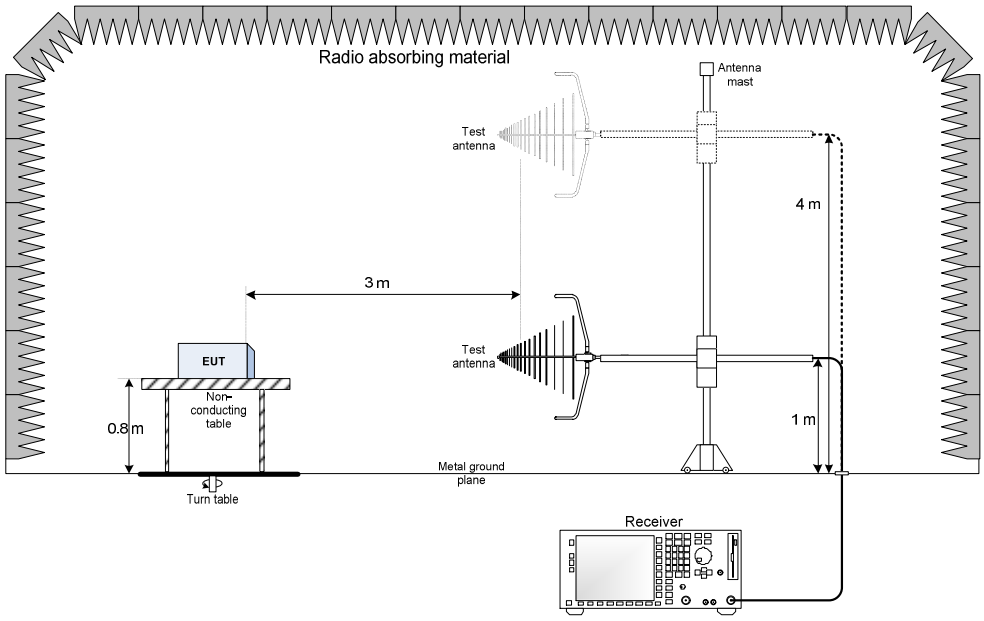
Test conditions	Frequency, MHz	Offset, ppm
+20 °C, +15 %	3690.007	-1.897
+20 °C	**3690.014**	Reference
+20 °C, -15 %	3690.020	1.626

Note: Offset was calculated as per the following formula:

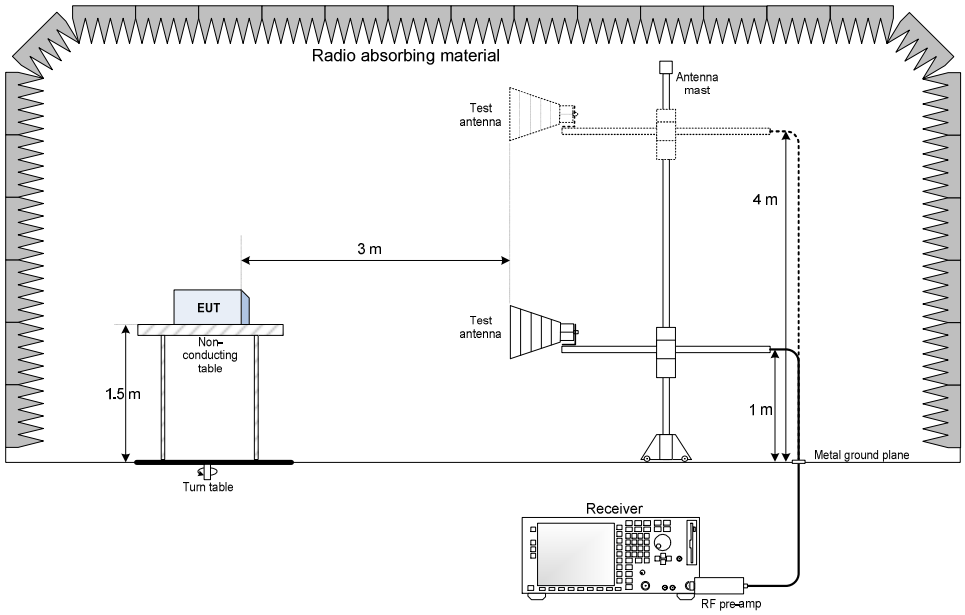
$$\frac{F_{Measured} - F_{reference}}{F_{reference}} \times 1 \cdot 10^{6}$$

Section 9. Block diagrams of test set-ups

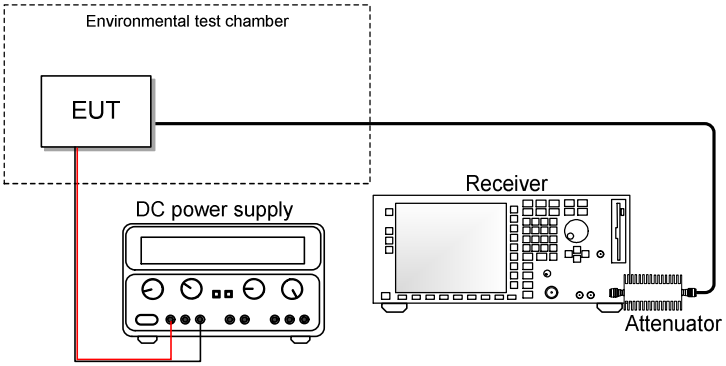
9.1 Radiated emissions set-up for frequencies below 1 GHz



9.2 Radiated emissions set-up for frequencies above 1 GHz



9.3 Conducted emissions set-up



Thank you for choosing